ELEMENTARY

CORE Academy

UTAH STATE OFFICE OF EDUCATION & UTAH STATE UNIVERSITY

ELEMENTARY CORE ACADEMY • ELEMENTARY CORE ACADEMY • ELEMENTARY

5TH GRADE

2008 Participant Handbook

UTAH STATE OFFICE OF EDUCATION

UtahState UNIVERSITY

ELEMENTARY CORE ACADEMY
6517 Old Main Hill
Logan, UT 84322-6517

435-797-0939
http://coreacademy.usu.edu

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Organizations:

Utah State Office of Education (USOE)
Utah State University (USU)
State Science Education Coordination Committee (SSECC)
State Mathematics Education Coordination Committee (SMECC)
Special Education Services Unit (USOE)

Individuals:

Academy Coordination Committee: Janet Gibbs, Velma Itamura, Max Longhurst, Nicole Paulson

Academy Director: Max Longhurst

Academy Coordinator: Ami Israelsen

Academy Facilitators: Rachel Alberts, Jer Call, Rita Stevenson, Stacie Williamson

Academy Presenters and Contributors: Gennie Kirch, Paul Nance, Marsha Newman, Dan Roberts, Cheryl Skinner, Kim Vance

Credits for editing, compiling, formatting, and assisting with the materials and delivery of the Elementary CORE Academy are given to Brynja Kohler and Elizabeth Shaw.

UTAH STATE OFFICE OF EDUCATION

Leadership…Service…Accountability

Patti Harrington, Ed.D.   State Superintendent of Public Instruction
Voice: (801) 538-7500   Fax: (801) 538-7521   TDD: (801) 538-7876
250 East Cesar E. Chavez Blvd. (500 South) P.O. Box 144200 Salt Lake City, Utah 84114-4200

Dear CORE Academy Teachers:

Thank you for your investment in children and in building your own expertise as you participate in the Elementary CORE Academy. I hope your involvement helps you to sustain a laser-like focus on student achievement.

Teachers in Utah are superb. By participating in the Academy, you join a host of teachers throughout the state who understand that teaching targeted on the core curricula, across a spectrum of subjects, will produce results of excellence. The research is quite clear–the closer the match of explicit instruction to core standards, the better the outcome on core assessments.

I personally appreciate your excellence and your desire to create wonderful classrooms of learning for students. Thank you for your dedication. I feel honored to associate with you and pledge my support to lead education in ways that benefit all of our children.

Sincerely,

Patti Harrington

Patti Harrington, Ed.D.
State Superintendent of Public Instruction

Funding Sources

Appreciation is expressed for the tremendous educational input and monetary commitment of several organizations for the successful delivery of the Elementary CORE Academy. This year's Elementary CORE Academy was developed and funded through a variety of sources. The Utah State Office of Education (USOE), in collaboration with Utah State University (USU) and local school districts of Utah, have supported kindergarten through sixth grade teachers with professional development experiences that will enhance the educational experience for Utah children.

Major funding for the Academy comes from the following sources:

Federal/State Funds:

Utah State Office of Education
Staff Development Funds
Special Education Services Unit

ESEA Title II

Utah Math Science Partnership

District Funds:

Various sources including Quality Teacher Block, Federal ESEA Title II, and District Professional Development Funds

School Funds:

Trust land, ESEA Title II, and other school funds
Utah State Office of Education Special Education Services

The state and district funds are allocations from the state legislature. ESEA is part of the "No Child Left Behind" funding that comes to Utah.

Additionally, numerous school districts, individual schools, and principals in Utah have sponsored teachers to attend the Academy. Other educational groups have assisted in the development and delivery of resources in the Academy.

Most important is the thousands of teachers who take time from their summer to attend these professional development workshops. It is these teachers who make this program possible.

Goals of the Elementary CORE Academy

Overall

The purpose of the Elementary CORE Academy is to create high quality teacher instruction and improve student achievement through the delivery of professional development opportunities and experiences for teachers across Utah.

The Academy will provide elementary teachers in Utah with:

1. Models of exemplary and innovative instructional strategies, tools, and resources to meet the Core Curriculum standards, objectives, and indicators.
2. Practical models and diverse methods of meeting the learning needs of all children, with instruction implementation aligned to the Core Curriculum.
3. Meaningful opportunities for collaboration, self-reflection, and peer discussion specific to innovative and effective instructional techniques, materials, teaching strategies, and professional practices in order to improve classroom instruction.

Learning a limited set of facts will no longer prepare a student for real experiences encountered in today's world. It is imperative that educators have continued opportunities to obtain instructional skills and strategies that provide methods of meeting the needs of all students. Participants of the Academy experience will be better equipped to meet the challenges faced in today's classrooms.

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Core Curriculum

Utah Elementary Math Core Curriculum

Introduction

Most children enter school confident in their own abilities; they are curious and eager to learn more. They make sense of the world by reasoning and problem solving. Young students are building beliefs about what mathematics is, about what it means to know and do mathematics, and about themselves as mathematical learners. Students use mathematical tools, such as manipulative materials and technology, to develop conceptual understanding and solve problems as they do mathematics. Students, as mathematicians, learn best through participatory experiences throughout the instruction of the mathematics curriculum.

Recognizing that no term captures completely all aspects of expertise, competence, knowledge, and facility in mathematics, the term *mathematical proficiency* has been chosen to capture what it means to learn mathematics successfully. Mathematical proficiency has five strands: computing (carrying out mathematical procedures flexibly, accurately, efficiently, and appropriately), understanding (comprehending mathematical concepts, operations, and relations), applying (ability to formulate, represent, and solve mathematical problems), reasoning (logically explaining and justifying a solution to a problem), and engaging (seeing mathematics as sensible, useful, and doable, and being able to do the work) (NRC, 2001).

The most important observation about the five strands of mathematical proficiency is that they are interwoven and interdependent. This observation has implications for how students acquire mathematical proficiency, how teachers develop that proficiency in their students, and how teachers are educated to achieve that goal. At any given moment during a mathematics lesson or unit, one or two strands might be emphasized. But all the strands must eventually be addressed so that the links among them are strengthened. The integrated and balanced development of all five strands of mathematical proficiency should guide the teaching and learning of school mathematics. Instruction should not be based on the extreme positions that students learn solely by internalizing what a teacher or book says, or solely by inventing mathematics on their own.

The Elementary Mathematics Core describes what students should know and be able to do at the end of each of the K-6 grade levels. It was developed and revised by a community of Utah mathematics teachers, mathematicians, university mathematics educators, and State Office of Education specialists. It was critiqued by an advisory committee representing a wide variety of people from the community, as well as an external review committee. The Core reflects the current philosophy of mathematics education that is expressed in national documents developed by the National Council of Teachers of Mathematics, the American Association for the Advancement of Science, and the National Research Council. This Mathematics Core has the endorsement of the Utah Council of Teachers of Mathematics. The Core reflects high standards of achievement in mathematics for all students.

Organization of the Elementary Mathematics Core

The Core is designed to help teachers organize and deliver instruction.

- Each grade level begins with a brief description of areas of instructional emphasis which can serve as organizing structures for curriculum design and instruction.
- The INTENDED LEARNING OUTCOMES (ILOs) describe the skills and attitudes students should acquire as a result of successful mathematics instruction. They are found at the beginning of each grade level and are an integral part of the Core.
- A STANDARD is a broad statement of what students are expected to understand. Several Objectives are listed under each Standard.
- An OBJECTIVE is a more focused description of what students need to know and be able to do at the completion of instruction. If students have mastered the Objectives associated with a given Standard, they have mastered that Standard at that grade level. Several Indicators are described for each Objective.
- INDICATORS are observable or measurable student actions that enable students to master an Objective. Indicators can help guide classroom instruction.
- MATHEMATICAL LANGUAGE AND SYMBOLS STUDENTS SHOULD USE includes language and symbols students should use in oral and written language.
- EXPLORATORY CONCEPTS AND SKILLS are included to establish connections with learning in subsequent grade levels. They are not intended to be assessed at the grade level indicated.

Guidelines Used in Developing the Elementary Mathematics Core

The Core is:

Consistent With the Nature of Learning

In the early grades, children are forming attitudes and habits for learning. It is important that instruction maximizes students' potential and gives them understanding of the intertwined nature of learning. The main intent of mathematics instruction is for students to value and use mathematics as a process to understand the world. The Core is designed to produce an integrated set of Intended Learning Outcomes for students.

Coherent

The Core has been designed so that, wherever possible, the ideas taught within a particular grade level have a logical and natural connection with each other and with those of earlier grades. Efforts have also been made to select topics and skills that integrate well with one another and with other subject areas appropriate to grade level. In addition, there is an upward articulation of mathematical concepts and skills. This spiraling is intended to prepare students to understand and use more complex mathematical concepts and skills as they advance through the learning process.

Developmentally Appropriate

The Core takes into account the psychological and social readiness of students. It builds from concrete experiences to more abstract understandings. The Core focuses on providing experiences with concepts that students can explore and understand in depth to build the foundation for future mathematical learning experiences.

Reflective of Successful Teaching Practices

Learning through play, movement, and adventure is critical to the early development of the mind and body. The Core emphasizes student exploration. The Core is designed to encourage a variety of interactive learning opportunities. Instruction should include recognition of the role of mathematics in the classroom, school, and community.

Comprehensive

By emphasizing <u>depth</u> rather than <u>breadth</u>, the Elementary Mathematics Core seeks to empower students by providing a comprehensive background in mathematics. Teachers are expected to teach all the standards and objectives specified in the Core for their grade level, but may add related concepts and skills.

The Core is:

- Coherent
- Developmentally Appropriate
- Encourages Good Teaching Practices
- Comprehensive
- Feasible
- Useful and Relevant
- Encourages Good Assessment Practices

Feasible

Teachers and others who are familiar with Utah students, classrooms, teachers, and schools have designed the Core. It can be taught with easily obtained resources and materials. A handbook is also available for teachers and has sample lessons on each topic for each grade level. The handbook is a document that will grow as teachers add exemplary lessons aligned with the new Core.

Useful and Relevant

This curriculum relates directly to student needs and interests. The relevance of mathematics to other endeavors enables students to transfer skills gained from mathematics instruction into their other school subjects and into their lives outside the classroom.

Reliant Upon Effective Assessment Practices

Student achievement of the standards and objectives in this Core is best assessed using a variety of assessment instruments. Performance tests are particularly appropriate to evaluate student mastery of mathematical processes and problem-solving skills. Teachers should use a variety of classroom assessment approaches in conjunction with standard assessment instruments to inform instruction. Sample test items, keyed to each Core Standard, may be located on the "Utah Mathematics Home Page" at http://www.usoe.k12.ut.us/curr/math. Observation of students engaged in instructional activities is highly recommended as a way to assess students' skills as well as attitudes toward learning. The nature of the questions posed by students provides important evidence of their understanding of mathematics.

Based Upon the National Council of Teachers of Mathematics Curriculum Focal Points

In 2006, the National Council of Teachers of Mathematics (NCTM) published ***Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics*** (NCTM, 2006). This document is available online at http://www.nctm.org/focalpoints. This document describes three focal points for each grade level. NCTM's focal points are areas of emphasis recommended for the curriculum of each grade level. The focal points within a grade are ***not the entire curriculum*** for that particular grade; however, Utah's Core Curriculum was designed to include these areas of focus.

Intended Learning Outcomes for Third through Sixth Grade Mathematics

The main intent of mathematics instruction is for students to value and use mathematics and reasoning skills to investigate and understand the world.

The Intended Learning Outcomes (ILOs) describe the skills and attitudes students should acquire as a result of successful mathematics instruction. They are an essential part of the Mathematics Core Curriculum and provide teachers with a standard for student learning in mathematics.

ILOs for mathematics:

1. **Develop a positive learning attitude toward mathematics.**
2. **Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.**
3. **Reason logically, using inductive and deductive strategies and justify conclusions.**
4. **Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.**
5. **Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.**
6. **Represent mathematical ideas in a variety of ways.**

Significant mathematics understanding occurs when teachers incorporate ILOs in planning mathematics instruction. The following are ideas to consider when planning instruction for students to acquire the ILOs:

1. **Develop a positive learning attitude toward mathematics.**

   When students are confident in their mathematical abilities, they demonstrate persistence in completing tasks. They pose mathematical questions about objects, events, and processes while displaying a sense of curiosity about numbers and patterns. It is important to build on students' innate problem-solving inclinations and to preserve and encourage a disposition that values mathematics.

2. **Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.**

   Problem solving is the cornerstone of mathematics. Mathematical knowledge is generated through problem solving as students explore mathematics. To become effective problem solvers, students need many opportunities to formulate questions and model problem situations in a variety of ways. They should generalize mathematical relationships and solve problems in both mathematical and everyday contexts.

3. **Reason logically, using inductive and deductive strategies and justify conclusions.**

   Mathematical reasoning develops in classrooms where students are encouraged to put forth their own ideas for examination. Students develop their reasoning skills by making and testing mathematical conjectures, drawing logical conclusions, and justifying their thinking in developmentally appropriate ways. Students use models, known facts, and relationships to explain reasoning. As they advance through the grades, students' arguments become more sophisticated.

4. **Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.**

   The ability to express mathematical ideas coherently to peers, teachers, and others through oral and written language is an important skill in mathematics. Students develop this skill and deepen their understanding of mathematics when they use accurate mathematical language to talk and write about what they are doing. When students talk and write about mathematics, they clarify their ideas and learn how to make convincing arguments and represent mathematical ideas verbally, pictorially, and symbolically.

5. **Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.**

   Students develop a perspective of the mathematics field as an integrated whole by understanding connections within mathematics. Students should be encouraged to explore the connections that exist with other disciplines and between mathematics and their own experiences.

6. **Represent mathematical ideas in a variety of ways.**

   Mathematics involves using various types of representations including concrete, pictorial, and symbolic models. In particular, identifying and locating numbers on the number line has a central role in uniting all numbers to promote understanding of equivalent representations and ordering. Students also use a variety of mathematical representations to expand their capacity to think logically about mathematics.

Fifth Grade Mathematics Standards

By the end of grade five, students increase their facility with the four basic arithmetic operations applied to whole numbers, fractions, and decimals. They locate integers on a number line and ordered pairs of integers on the coordinate plane. They determine rules for numerical patterns, work with expressions including order of operations, and solve single-operation equations involving a single variable. They classify angles, triangles, and quadrilaterals, and analyze relationships among lines, triangles and quadrilaterals. They recognize and determine surface area and volume of three-dimensional shapes, including right prisms. Students understand the concepts of mean, median, mode, and range of data sets and can calculate them. They use line plots, bar graphs, and line graphs to record and analyze data.

Standard I: Students will expand number sense to include integers and perform operations with whole numbers, simple fractions, and decimals.

Standard I:
Students will expand number sense to include integers and perform operations with whole numbers, simple fractions, and decimals.

Objective 1: Represent whole numbers and decimals from thousandths to one billion, fractions, percents, and integers.

a. Read and write numbers in standard and expanded form.
b. Demonstrate multiple ways to represent whole numbers, decimals, fractions, percents, and integers using models and symbolic representations (e.g., $108 = 2 \times 50 + 8$; $108 = 10^2 + 8$; 90% = 90 out of 100 squares on a hundred chart).
c. Identify, read, and locate fractions, mixed numbers, decimals, and integers on the number line.
d. Represent repeated factors using exponents.
e. Describe situations where integers could be used in the students' environment.

Objective 2: Explain relationships and equivalencies among integers, fractions, decimals, and percents.

a. Compare fractions by finding a common denominator.
b. Order integers, fractions (including mixed numbers), and decimals using a variety of methods, including the number line.

c. Rewrite mixed numbers and improper fractions from one form to the other and represent each using regions, sets of objects, or line segments.

d. Represent commonly used fractions as decimals and percents in a variety of ways (e.g., models, fraction strips, pictures, calculators, algorithms).

e. Model and calculate equivalent forms of a fraction (including simplest form).

f. Rename whole numbers as fractions with different denominators (e.g., 5 = 5/1, 3 = 6/2, 1 = 7/7).

Objective 3: Use number theory concepts to develop and use divisibility tests; classify whole numbers to 50 as prime, composite, or neither; and find common multiples and factors.

a. Identify patterns with skip counting and multiples to develop and use divisibility tests for determining whether a whole number is divisible by 2, 3, 5, 6, 9, and 10.

b. Use strategies for classifying whole numbers to 50 as prime, composite, or neither.

c. Rewrite a composite number between 2 and 50 as a product of only prime numbers.

d. Find common multiples and factors and apply to adding and subtracting fractions.

Objective 4: Model and illustrate meanings of multiplication and division.

a. Represent division-with-remainder using whole numbers, decimals, or fractions.

b. Describe the effect of place value when multiplying and dividing whole numbers and decimals by 10, 100, and 1,000.

c. Model multiplication of fractions and decimals (e.g., tenths multiplied by tenths, a whole number multiplied by tenths, or a whole number with tenths multiplied by tenths) in a variety of ways (e.g., manipulatives, number line and area models, patterns).

Objective 5: Solve problems involving one or two operations.

a. Determine when it is appropriate to use estimation, mental math strategies, paper and pencil, and algorithms.

b. Make reasonable estimations of fraction and decimal sums, differences, and products, including knowing whether results obtained using a calculator are reasonable.

c. Write number sentences that can be used to solve a two-step problem.

d. Interpret division-with-remainder problems as they apply to the environment (e.g., If there are 53 people, how many vans are needed if each van holds 8 people?).

Objective 6: Demonstrate proficiency with multiplication and division of whole numbers and compute problems involving addition, subtraction, and multiplication of decimals and fractions.

a. Multiply multi-digit whole numbers by a two-digit whole number with fluency, using efficient procedures.

b. Divide multi-digit dividends by a one-digit divisor with fluency, using efficient procedures.

c. Add and subtract decimals with fluency, using efficient procedures.

d. Add and subtract fractions with fluency.

e. Multiply fractions.

Mathematical language and symbols students should use

prime, composite, exponent, fractions, numerator, denominator, common denominator, common factor, common multiple, decimals, percents, divisible, divisibility, equivalent fractions, integer, dividend, quotient, divisor, factor, order of operations, simplest terms, various symbols for multiplication and division, mixed numeral, improper fraction

Exploratory Concepts and Skills

- Extend classification of whole numbers from 0-100 as prime, composite, or neither.
- Apply rules of divisibility.
- Explore adding and subtracting integers.
- Divide multi-digit dividends by a two-digit divisor.

Standard II: Students will use patterns and relations to represent and analyze mathematical problems and number relationships using algebraic symbols.

Objective 1: Identify, analyze and determine a rule for predicting and extending numerical patterns involving operations whole numbers, decimals, and fractions.

a. Analyze and make predictions about numeric patterns, including decimals and fractions.

b. Determine a rule for the pattern using organized lists, tables, objects, and variables.

Standard II:
Students will use patterns and relations to represent and analyze mathematical problems and number relationships using algebraic symbols.

Objective 2: Use algebraic expressions, inequalities, or equations to represent and solve simple real-world problems. −

a. Use properties and the order of operations involving addition, subtraction, multiplication, division, and the use of parentheses to compute with whole numbers, decimals, and fractions.

b. Use patterns, models, and relationships as contexts for writing and solving simple equations and inequalities with whole number solutions (e.g., 6x = 54; x + 3 = 7).

Mathematical language and symbols students should use

variety of symbols for multiplication and division such as x, i, and * as symbols for multiplication and ÷, e, and a fraction bar (/ or —) as division symbols; variable, order of operations, parentheses, inequality, expression, equation, associative property, commutative property, distributive property

Exploratory Concepts and Skills

- Extend classification of whole numbers from 0-100 as prime, composite, or Solve multi-step equations.
- Construct and analyze tables involving equivalent ratios.

Standard III: Students will use spatial reasoning to recognize, describe, and analyze geometric shapes and principles.

Objective 1: Describe relationships between two- and three-dimensional shapes and analyze attributes and properties of geometric shapes.

a. Draw, label, and describe line segments, rays, lines, parallel lines, and perpendicular lines.

b. Draw, label, and define an angle as two rays sharing a common endpoint (vertex).

c. Classify triangles and quadrilaterals and analyze the relationships among the shapes in each classification (e.g., a square is a rectangle).

d. Relate pyramids and right prisms to the two-dimensional shapes (nets) from which they were created.

e. Identify properties and attributes of solids (i.e., right prisms, pyramids, cylinders, cones) and describe them by the number of edges, faces, and vertices as well as the types of faces.

Objective 2: Specify locations in a coordinate plane.

a. Locate points defined by ordered pairs of integers.

b. Write an ordered pair for a point in a coordinate plane with integer coordinates.

c. Specify possible paths between locations on a coordinate plane and compare distances of the various paths.

Mathematical language and symbols students should use

perpendicular and parallel lines, rays, angles (acute, obtuse, right, straight), triangles (equilateral, isosceles, scalene, right, acute, obtuse), vertex, vertices, edge, face, corresponding angles, similar, polygon, pyramid, right prism

Exploratory Concepts and Skills

- Compare corresponding angles of two triangles and determine whether the triangles are similar.
- Rotate a shape around a fixed point and identify the location of the new vertices.
- Translate a polygon either horizontally or vertically on a coordinate grid and identify the location of the new vertices.
- Reflect a shape across either the x- or y-axis and identify the location of the new vertices.

Standard III:
Students will use spatial reasoning to recognize, describe, and analyze geometric shapes and principles.

Standard IV: Students will determine area of polygons and surface area and volume of three-dimensional shapes.

Standard IV: Students will determine area of polygons and surface area and volume of three-dimensional shapes.

Objective 1: Determine the area of polygons and apply to real-world problems.

a. Determine the area of a trapezoid by the composition and decomposition of rectangles, triangles, and parallelograms.

b. Determine the area of irregular and regular polygons by the composition and decomposition of rectangles, triangles, and parallelograms.

c. Compare areas of polygons using different units of measure within the same measurement system (e.g., square feet, square yards).

Objective 2: Recognize, describe, and determine surface area and volume of three-dimensional shapes.

a. Quantify volume by finding the total number of same-sized units of volume needed to fill the space without gaps or overlaps.

b. Recognize that a cube having a 1 unit edge is the standard unit for measuring volume expressed as a cubic unit.

c. Derive and use the formula to determine the volume of a right prism with a triangular or rectangular base.

d. Relate the formulas for the areas of triangles, rectangles, or parallelograms to the surface area of a right prism.

e. Derive and use the formula to determine the surface area of a right prism and express surface area in square units.

Mathematical language and symbols students should use

area, volume, surface area, volume, right prism

Exploratory Concepts and Skills

- Investigate pi as the ratio of the circumference to the diameter of a circle.
- Determine the volume of a right prism with various bases.

Standard V: Students will construct, analyze, and construct reasonable conclusions from data and apply basic concepts of probability.

Objective 1: Formulate and answer questions using statistical methods to compare data, and propose and justify inferences based on data.

a. Construct, analyze, and display data using an appropriate format (e.g., line plots, bar graphs, line graphs).

b. Recognize the differences in representing categorical and numerical data.

c. Identify minimum and maximum values for a set of data.

d. Identify and calculate the mean, median, mode, and range.

Objective 2: Apply basic concepts of probability.

a. Describe the results of experiments involving random outcomes using a variety of notations (e.g., 4 out of 9, 4/9).

b. Recognize that probability is always a value between 0 and 1 (inclusively).

c. Express the likelihood of an outcome in a simple experiment as a value between 0 and 1 (inclusively).

Mathematical language and symbols students should use

data, minimum values, maximum values, mean, median, mode, average, range

Exploratory Concepts and Skills

- Explore the differences in representing categorical and numerical data.

Standard V:
Students will construct, analyze, and construct reasonable conclusions from data and apply basic concepts of probability.

Utah Elementary Science Core Curriculum

Introduction

Science is a way of knowing, a process for gaining knowledge and understanding of the natural world. The Science Core Curriculum places emphasis on understanding and using skills. Students should be active learners. It is not enough for students to read about science; they must do science. They should observe, inquire, question, formulate and test hypotheses, analyze data, report, and evaluate findings. The students, as scientists, should have hands–on, active experiences throughout the instruction of the science curriculum.

The Elementary Science Core describes what students should know and be able to do at the end of each of the K–6 grade levels. It was developed, critiqued, piloted, and revised by a community of Utah science teachers, university science educators, State Office of Education specialists, scientists, expert national consultants, and an advisory committee representing a wide variety of people from the community. The Core reflects the current philosophy of science education that is expressed in national documents developed by the American Association for the Advancement of Science, the National Academies of Science. This Science Core has the endorsement of the Utah Science Teachers Association. The Core reflects high standards of achievement in science for all students.

Organization of the Elementary Science Core

The Core is designed to help teachers organize and deliver instruction.

The Science Core Curriculum's organization:

- Each grade level begins with a brief course description.
- The INTENDED LEARNING OUTCOMES (ILOs) describe the goals for science skills and attitudes. They are found at the beginning of each grade, and are an integral part of the Core that should be included as part of instruction.
- The SCIENCE BENCHMARKS describe the science content students should know. Each grade level has three to five Science Benchmarks. The ILOs and Benchmarks intersect in the Standards, Objectives and Indicators.

- A STANDARD is a broad statement of what students are expected to understand. Several Objectives are listed under each Standard.
- An OBJECTIVE is a more focused description of what students need to know and be able to do at the completion of instruction. If students have mastered the Objectives associated with a given Standard, they are judged to have mastered that Standard at that grade level. Several Indicators are described for each Objective.
- An INDICATOR is a measurable or observable student action that enables one to judge whether a student has mastered a particular Objective. Indicators are not meant to be classroom activities, but they can help guide classroom instruction.

The Core is:

- Coherent
- Developmentally Appropriate
- Encourages Good Teaching Practices
- Comprehensive
- Feasible
- Useful and Relevant
- Encourages Good Assessment Practices

Guidelines Used in Developing the Elementary Science Core

Reflects the Nature of Science

Science is a way of knowing, a process of gaining knowledge and understanding of the natural world. The Core is designed to produce an integrated set of Intended Learning Outcomes (ILOs) for students. Please see the Intended Learning Outcomes document for each grade level core.

As described in these ILOs, students will:

1. Use science process and thinking skills.
2. Manifest science interests and attitudes.
3. Understand important science concepts and principles.
4. Communicate effectively using science language and reasoning.
5. Demonstrate awareness of the social and historical aspects of science.
6. Understand the nature of science.

Coherent

The Core has been designed so that, wherever possible, the science ideas taught within a particular grade level have a logical and natural connection with each other and with those of earlier grades. Efforts have also been made to select topics and skills that integrate well with one another and with other subject areas appropriate to grade level. In addition, there is an upward articulation of science concepts, skills, and content. This spiraling is intended to prepare students to understand and use more complex science concepts and skills as they advance through their science learning.

Developmentally Appropriate

The Core takes into account the psychological and social readiness of students. It builds from concrete experiences to more abstract understandings. The Core describes science language students should use that is appropriate to each grade level. A more extensive vocabulary should not be emphasized. In the past, many educators may have mistakenly thought that students understood abstract concepts (such as the nature of the atom), because they repeated appropriate names and vocabulary (such as electron and neutron). The Core resists the temptation to tell about abstract concepts at inappropriate grade levels, but focuses on providing experiences withconcepts that students can explore and understand in depth to build a foundation for future science learning.

Encourages Good Teaching Practices

It is impossible to accomplish the full intent of the Core by lecturing and having students read from textbooks. The Elementary Science Core emphasizes student inquiry. Science process skills are central in each standard. Good science encourages students to gain knowledge by doing science: observing, questioning, exploring, making and testing hypotheses, comparing predictions, evaluating data, and communicating conclusions. The Core is designed to encourage instruction with students working in cooperative groups. Instruction should connect lessons with students' daily lives. The Core directs experiential science instruction for all students, not just those who have traditionally succeeded in science classes. The vignettes listed on the "Utah Science Home Page" at http://www.usoe.k12.ut.us/curr/science for each of the Core standards provide examples, based on actual practice, that demonstrate that excellent teaching of the Science Core is possible.

Comprehensive

The Elementary Science Core does not cover all topics that have traditionally been in the elementary science curriculum; however, it does provide a comprehensive background in science. By emphasizing depth rather than breadth, the Core seeks to empower students rather than intimidate them with a collection of isolated and eminently forgettable facts. Teachers are free to add related concepts and skills, but they are expected to teach all the standards and objectives specified in the Core for their grade level.

Feasible

Teachers and others who are familiar with Utah students, classrooms, teachers, and schools have designed the Core. It can be taught with easily obtained resources and materials. A Teacher Resource Book (TRB) is available for elementary grades and has sample lessons on each topic for each grade level. The TRB is a document that will grow as teachers add exemplary lessons aligned with the new Core. The middle grade levels have electronic textbooks available at the Utah State Office of Education's "Utah Science Home Page" at http://www.usoe.k12.ut.us/curr/science.

Useful and Relevant

This curriculum relates directly to student needs and interests. It is grounded in the natural world in which we live. Relevance of science to other endeavors enables students to transfer skills gained from science instruction into their other school subjects and into their lives outside the classroom.

Encourages Good Assessment Practices

Student achievement of the standards and objectives in this Core are best assessed using a variety of assessment instruments. One's purpose should be clearly in mind as assessment is planned and implemented. Performance tests are particularly appropriate to evaluate student mastery of science processes and problem-solving skills. Teachers should use a variety of classroom assessment approaches in conjunction with standard assessment instruments to inform their instruction. Sample test items, keyed to each Core Standard, may be located on the Utah Science Home Page. Observation of students engaged in science activities is highly recommended as a way to assess students' skills as well as attitudes in science. The nature of the questions posed by students provides important evidence of students' understanding of science.

The Most Important Goal

Elementary school reaches the greatest number of students for a longer period of time during the most formative years of the school experience. Effective elementary science instruction engages students actively in enjoyable learning experiences. Science instruction should be as thrilling an experience for a child as seeing a rainbow, growing a flower, or holding a toad. Science is not just for those who have traditionally succeeded in the subject, and it is not just for those who will choose science–related careers. In a world of rapidly expanding knowledge and technology, all students must gain the skills they will need to understand and function responsibly and successfully in the world. The Core provides skills in a context that enables students to experience the joy of doing science.

Fifth Grade Science Core Curriculum

In the Fifth Grade, students begin to understand concepts of Change and Cause and Effect. Students will learn about the constantly changing Earth's surface. They will investigate physical and chemical changes in matter. They will begin to relate causes for changes with their effects. Students will have opportunity to investigate the effects of various forces, such as magnetism and electricity upon materials. They will begin to learn how traits passed from parent organisms to their offspring effect their survival.

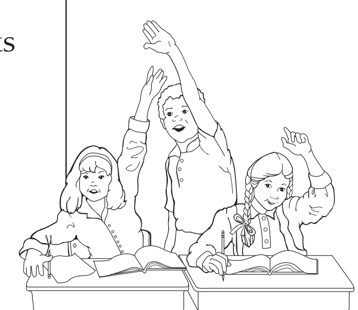
Students should learn to value the scientific processes as means of obtaining knowledge. They should be encouraged to maintain an open and questioning mind and should be helped and encouraged to pose their own questions about objects, events, processes and results. Fifth graders should have the opportunity to plan and conduct their own experiments and come to their own conclusions as they read, observe, compare, describe, infer and draw conclusions.

Good science instruction requires hands–on science investigations in which student inquiry is an important goal. Teachers should provide opportunities for all students to explore many things. Fifth graders should have sufficient understanding of Earth Science to point out an interesting landform to others and hypothesize its origin; feel the success of connecting batteries and wire to make the lights come on; learn about chemical change as they mix baking soda and vinegar and test changes in acidity of liquids using the juice of red cabbage leaves. They should come to enjoy science as a process of learning about their world.

Science Core concepts should be integrated with concepts and skills from other curriculum areas. Reading, writing and mathematics skills should be emphasized as integral to the instruction of science. Technology issues and the nature of science are significant components of this Core. Personal relevance of science in students' lives is always an important part of helping students to value science and should be emphasized at this grade level.

This Core was designed using the American Association for the Advancement of Science's Project 2061: Benchmarks For Science Literacy and the National Academy of Science's National Science Education Standards as guides to determine appropriate content and skills.

- Value the scientific process
- Maintain and open and questioning mind
- Pose questions about objects, events, processes and results



The fifth grade Science Core has three online resources designed to help with classroom instruction; they include Teacher Resource Book—a set of lesson plans, assessment items and science information specific to fifth grade; Sci-ber Text—an electronic science textbook specific to the Utah Core, and the science test item pool. This pool includes multiple-choice questions, performance tasks, and interpretive items aligned to the standards and objectives of the fifth grade Science Core. These resources are all available on the Utah Science Home Page at: http://www.usoe.k12.ut.us/curr/science

Safety Precautions:

The hands–on nature of this science curriculum increases the need for teachers to use appropriate precautions in the classroom and field. Teachers must adhere to the published guidelines for the proper use of animals, equipment, and chemicals in the classroom. These guidelines are available on the Utah Science Home Page.

Intended Learning Outcomes for Fifth Grade Science

The Intended Learning Outcomes (ILOs) describe the skills and attitudes students should learn as a result of science instruction. They are an essential part of the Science Core Curriculum and provide teachers with a standard for evaluation of student learning in science. Instruction should include significant science experiences that lead to student understanding using the ILOs.

The main intent of science instruction in Utah is that students will value and use science as a process of obtaining knowledge based upon observable evidence.

By the end of fifth grade students will be able to:

1. Use Science Process and Thinking Skills
   a. Observe simple objects, patterns, and events and report their observations.
   b. Sort and sequence data according to criteria given.
   c. Given the appropriate instrument, measure length, temperature, volume, and mass in metric units as specified.
   d. Compare things, processes, and events.
   e. Use classification systems.
   f. Plan and conduct simple experiments.
   g. Formulate simple research questions.
   h. Predict results of investigations based on prior data.
   i. Use data to construct a reasonable conclusion.
2. Manifest Scientific Attitudes and Interests
   a. Demonstrate a sense of curiosity about nature.
   b. Voluntarily read and look at books and other materials about science.
   c. Pose science questions about objects, events, and processes.
   d. Maintain an open and questioning mind toward new ideas and alternative points of view.
   e. Seek and weigh evidence before drawing conclusions.
   f. Accept and use scientific evidence to help resolve ecological problems.
3. Understand Science Concepts and Principles
   a. Know and explain science information specified for the grade level.

- Use Science Process and Thinking Skills
- Manifest Scientific Attitudes and Interests
- Understand Science Concepts and Principles
- Communicate Effectively Using Science Language and Reasoning
- Demonstrate Awareness of Social and Historical Aspects of Science
- Understand the Nature of Science

b. Distinguish between examples and non-examples of concepts that have been taught.

c. Solve problems appropriate to grade level by applying science principles and procedures.

4. Communicate Effectively Using Science Language and Reasoning

   a. Record data accurately when given the appropriate form (e.g., table, graph, chart).

   b. Describe or explain observations carefully and report with pictures, sentences, and models.

   c. Use scientific language in oral and written communication.

   d. Use reference sources to obtain information and cite the source.

   e. Use mathematical reasoning to communicate information.

5. Demonstrate Awareness of Social and Historical Aspects of Science

   a. Cite examples of how science affects life.

   b. Understand the cumulative nature of science knowledge.

6. Understand the Nature of Science

   a. Science is a way of knowing that is used by many people not just scientists.

   b. Understand that science investigations use a variety of methods and do not always use the same set of procedures; understand that there is not just one "scientific method."

   c. Science findings are based upon evidence.

Fifth Grade Science Standards

Science Benchmark

The weight of an object is always equal to the sum of its parts, regardless of how it is assembled. In a chemical reaction or physical change matter is neither created nor destroyed. When two or more materials are combined, either a chemical reaction or physical change may occur. Chemical reactions are often indicated when materials give off heat or cool as they take in heat, give off light, give off gas, or change colors. In a chemical reaction, materials are changed into new substances. In a physical change a new substance is not formed.

Standard I: Students will understand that chemical and physical changes occur in matter.

Standard I:
Students will understand that chemical and physical changes occur in matter.

Objective 1: Describe that matter is neither created nor destroyed even though it may undergo change.

a. Compare the total weight of an object to the weight of its individual parts after being disassembled.
b. Compare the weight of a specified quantity of matter before and after it undergoes melting or freezing.
c. Investigate the results of the combined weights of a liquid and a solid after the solid has been dissolved and then recovered from the liquid (e.g., salt dissolved in water then water evaporated).
d. Investigate chemical reactions in which the total weight of the materials before and after reaction is the same (e.g., cream and vinegar before and after mixing, borax and glue mixed to make a new substance).

Objective 2: Evaluate evidence that indicates a physical change has occurred.

a. Identify the physical properties of matter (e.g., hard, soft, solid, liquid, gas).
b. Compare changes in substances that indicate a physical change has occurred.
c. Describe the appearance of a substance before and after a physical change.

Objective 3: Investigate evidence for changes in matter that occur during a chemical reaction.

a. Identify observable evidence of a chemical reaction (e.g., color change, heat or light given off, heat absorbed, gas given off).
b. Explain why the measured weight of a remaining product is less than its reactants when a gas is produced.
c. Cite examples of chemical reactions in daily life.
d. Compare a physical change to a chemical change.
e. Hypothesize how changing one of the materials in a chemical reaction will change the results.

Science language students should use:

heat, substance, chemical change, dissolve, physical change, matter, product, reactants, solid, liquid, weight

Science Benchmark

The Earth's surface is constantly changing. Some changes happen very slowly over long periods of time, such as weathering, erosion, and uplift. Other changes happen abruptly, such as landslides, volcanic eruptions, and earthquakes. All around us, we see the visible effects of the building up and breaking down of the Earth's surface.

Standard II: Students will understand that volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth's surface.

Objective 1: Describe how weathering and erosion change Earth's surface.

a. Identify the objects, processes, or forces that weather and erode Earth's surface (e.g., ice, plants, animals, abrasion, gravity, water, wind).

b. Describe how geological features (e.g., valleys, canyons, buttes, arches) are changed through erosion (e.g., waves, wind, glaciers, gravity, running water).

c. Explain the relationship between time and specific geological changes.

Objective 2: Explain how volcanoes, earthquakes, and uplift affect Earth's surface.

a. Identify specific geological features created by volcanoes, earthquakes, and uplift.

b. Give examples of different landforms that are formed by volcanoes, earthquakes, and uplift (e.g., mountains, valleys, new lakes, canyons).

c. Describe how volcanoes, earthquakes, and uplift change landforms.

d. Cite examples of how technology is used to predict volcanoes and earthquakes.

Objective 3: Relate the building up and breaking down of Earth's surface over time to the various physical land features.

a. Explain how layers of exposed rock, such as those observed in the Grand Canyon, are the result of natural processes acting over long periods of time.

b. Describe the role of deposition in the processes that change Earth's surface.

c. Use a time line to identify the sequence and time required for building and breaking down of geologic features on Earth.

Standard II:
Students will understand that volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth's surface.

d. Describe and justify how the surface of Earth would appear if there were no mountain uplift, weathering, or erosion.

Science language students should use:
earthquakes, erode, erosion, faults, uplift, volcanoes, weathering, buttes, arches, glaciers, geological, deposition

Science Benchmark

Earth and some earth materials have magnetic properties. Without touching them, a magnet attracts things made of iron and either pushes or pulls on other magnets. Electricity is a form of energy. Current electricity can be generated and transmitted through pathways. Some materials are capable of carrying electricity more effectively than other materials. Static electricity is a result of objects being electrically charged. Without touching them, materials that are electrically charged may either push or pull other charged materials.

Standard III: Students will understand that magnetism can be observed when there is an interaction between the magnetic fields of magnets or between a magnet and materials made of iron.

Objective 1: Investigate and compare the behavior of magnetism using magnets.

a. Compare various types of magnets (e.g., permanent, temporary, and natural magnets) and their abilities to push or pull iron objects they are not touching.

b. Investigate how magnets will both attract and repel other magnets.

c. Compare permanent magnets and electromagnets.

d. Research and report the use of magnets that is supported by sound scientific principles.

Objective 2: Describe how the magnetic field of Earth and a magnet are similar.

a. Compare the magnetic fields of various types of magnets (e.g., bar magnet, disk magnet, horseshoe magnet).

b. Compare Earth's magnetic field to the magnetic field of a magnet.

c. Construct a compass and explain how it works.

d. Investigate the effects of magnets on the needle of a compass and compare this to the effects of Earth's magnetic field on the needle of a compass (e.g., magnets effect the needle only at close distances, Earth's magnetic field affects the needle at great distances, magnets close to a compass overrides the Earth's effect on the needle).

Standard III: Students will understand that magnetism can be observed when there is an interaction between the magnetic fields of magnets or between a magnet and materials made of iron.

Standard IV: Students will understand features of static and current electricity.

Objective 1: Describe the behavior of static electricity as observed in nature and everyday occurrences.

a. List several occurrences of static electricity that happen in everyday life.

b. Describe the relationship between static electricity and lightning.

c. Describe the behavior of objects charged with static electricity in attracting or repelling without touching.

d. Compare the amount of static charge produced by rubbing various materials together (e.g., rubbing fur on a glass rod produces a greater charge then rubbing the fur with a metal rod, the static charge produced when a balloon is rubbed on hair is greater than when a plastic bag is rubbed on hair).

e. Investigate how various materials react differently to statically charged objects.

Objective 2: Analyze the behavior of current electricity.

a. Draw and label the components of a complete electrical circuit that includes switches and loads (e.g., light bulb, bell, speaker, motor).

b. Predict the effect of changing one or more of the components (e.g., battery, load, wires) in an electric circuit.

c. Generalize the properties of materials that carry the flow of electricity using data by testing different materials.

d. Investigate materials that prevent the flow of electricity.

e. Make a working model of a complete circuit using a power source, switch, bell or light, and a conductor for a pathway.

Science language students should use:
battery, complete circuit, incomplete circuit, current, conductor, insulator, pathway, power source, attract, compass, electromagnetism, magnetic force, magnetic field, natural magnet, permanent magnet, properties, repel, static electricity, temporary magnet, switch, load

Standard IV:
Students will understand features of static and current electricity.

Science Benchmark

All living things inherit a set of characteristics or traits from their parents. Members of any given species transfer traits from one generation to the next. The passing of traits from parent to offspring is called heredity and causes the offspring to resemble the parent. Some traits differ among members of a population, and these variations may help a particular species to survive better in a given environment in getting food, finding shelter, protecting itself, and reproducing. These variations give the individual a survival advantage over other individuals of the same species.

Standard V: Students will understand that traits are passed from the parent organisms to their offspring, and that sometimes the offspring may possess variations of these traits that may help or hinder survival in a given environment.

Objective 1: Using supporting evidence, show that traits are transferred from a parent organism to its offspring.

a. Make a chart and collect data identifying various traits among a given population (e.g., the hand span of students in the classroom, the color and texture of different apples, the number of petals of a given flower).

b. Identify similar physical traits of a parent organism and its offspring (e.g., trees and saplings, leopards and cubs, chickens and chicks).

c. Compare various examples of offspring that do not initially resemble the parent organism but mature to become similar to the parent organism (e.g., mealworms and darkling beetles, tadpoles and frogs, seedlings and vegetables, caterpillars and butterflies).

d. Contrast inherited traits with traits and behaviors that are not inherited but may be learned or induced by environmental factors (e.g., cat purring to cat meowing to be let out of the house; the round shape of a willow is inherited, while leaning away from the prevailing wind is induced).

e. Investigate variations and similarities in plants grown from seeds of a parent plant (e.g., how seeds from the same plant species can produce different colored flowers or identical flowers).

Standard V:
Students will understand that traits are passed from the parent organisms to their offspring, and that sometimes the offspring may possess variations of these traits that may help or hinder survival in a given environment.

Objective 2: Describe how some characteristics could give a species a survival advantage in a particular environment.

a. Compare the traits of similar species for physical abilities, instinctual behaviors, and specialized body structures that increase the survival of one species in a specific environment over another species (e.g., difference between the feet of snowshoe hare and cottontail rabbit, differences in leaves of plants growing at different altitudes, differences between the feathers of an owl and a hummingbird, differences in parental behavior among various fish).

b. Identify that some environments give one species a survival advantage over another (e.g., warm water favors fish such as carp, cold water favors fish such as trout, environments that burn regularly favor grasses, environments that do not often burn favor trees).

c. Describe how a particular physical attribute may provide an advantage for survival in one environment but not in another (e.g., heavy fur in arctic climates keep animals warm whereas in hot desert climates it would cause overheating; flippers on such animals as sea lions and seals provide excellent swimming structures in the water but become clumsy and awkward on land; cacti retain the right amount of water in arid regions but would develop root rot in a more temperate region; fish gills have the ability to absorb oxygen in water but not on land).

d. Research a specific plant or animal and report how specific physical attributes provide an advantage for survival in a specific environment.

Science language students should use:
inherited, environment, species, offspring, traits, variations, survival, instincts, population, specialized structure, organism, life cycle, parent organism, learned behavior

Facilitated

Activities

MATH Journal Table of Contents

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SCIENCE Journal Table of Contents

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Activity 1: (REST) Record-Edit-Synthesize-Think

Morgan, Meeks, Schollart, and Paul came up with a brilliant notetaking strategy in 1986 called REST. This strategy integrates textbooks, readings, lectures and class discussions. When students use REST, they record what they have read, edit those notes by deleting irrelevant material and condensing them, further refine notes by recording information stressed both in class lecture and the text and finally think about the notes while studying and learning. REST can be used when teachers assign reading before a class discussion or the other way around.

Directions:

1. Tell students you will be demonstrating a study and note-taking strategy they can use. Use an example from your content area (matter) or the following examples.
2. Identify a concept that will be the topic of a class discussion and an assigned reading. Have students read the passage independently.
3. Students should record notes from their reading on the left half of the paper similar to the example.
4. After students have read the information and taken notes on the left, the class will proceed to hear a class discussion the same topic. They should take notes on the right side of the paper.
5. Explain to students that they should look at both sides of their notes for important information. Some information will be repeated and some will only be mentioned on one side. They need to highlight information important to the overall concept.
6. The final step is to synthesize the information from the reading and the discussion into one statement. Students should read both columns of information carefully and write a summary at bottom of their paper that lists the most important information they highlighted from both columns.

Example:

REST	
Notes from text (pp. 17-19)	Notes from class
• St. Paul's Island in the Bering Sea near Alaska • 41 sq. miles • 1911-25 reindeer introduced • No predators • 1937 – reindeer population increased to 2,000 • By 1950 no more reindeer	• Food capacity of island limited • Inderdependence involves limiting factors • No data on reindeer population in 1941-1942 • Carrying capacity—maximum population of a particular species that the habitat can support
Summary Reindeer were introduced to St. Paul's Island, a small island in the Bering Sea, in 1911. The reindeer population increased for 26 years but then exceeded the carrying capacity of the habitat. Reindeer were extinct by 1950 due to lack of food.	

Activity 2: Cornell Note-taking

Cornell note-taking (Pauk, 1974) is similar to REST in that it is a two-column note-taking strategy. With Cornell note-taking, notes from textbook reading or class discussions are written on the right side of the page, and key words that organize the text are written on the right. This is a great strategy for topics organized into main ideas and details.

Directions:

1. Tell students you will be demonstrating a study and note-taking strategy they can use. Use an example from your content area (matter) or the following examples.
2. Use a topic that would be organized with the structure or main idea/details. Be sure students understand this type of text structure by giving a simple example. Conduct a class discussion on the topic or read a passage about the topic.
3. Hand out paper to students with a vertical line drawn approximately three inches from the left side of the paper. Explain to students they should take detailed notes on the RIGHT side of the paper as they are reading the passage or listening to the lecture.
4. Divide the glass into groups of three or four students. Have them share their notes from the right side of their papers. Ask them to come up with key words to write on the left side of their paper.
5. Tell students to independently decide which key terms would be appropriate to write on the left side of their notes.

Example:

Cornell Note-taking

Key Words	Notes from reading or class discussion
Louisiana Purchase Lewis and Clark Gold Rush Mormon Pioneers Transcontinental Railroad Native Americans	• Louisiana Purchase cost $15 million • Lewis and Clark were thought to be dead • Purchase made it possible for settlers to move west, but nervous about natives • Gold Rush in California brought thousands to California in just a few years • Pioneers used handcarts, oxen, wagons to cross the Great Plains. • Mormon pioneers settled Salt Lake City and created a rest point for other pioneers • Railroad completion halted by Civil War • Transcontinental Railroad cut trip to 2 weeks • Native American Removal Act moved Native Americans onto poor reservation land

Activity 3: (REAP) Read-Encode-Annotate-Ponder

Annotative notes are at the heart of the REAP strategy (Eanet & Manzo, 1976). During the process, students will READ text, ENCODE the message by translating the information into their own words, ANNOTATE or write their messages in their notes, and PONDER the messages they have written. Critical to this activity is the different types of ANNOTATIONS students make in their notes. There are Summary Annotations (condenses the ideas into one or two statements), Thesis Annotations (states the main point the author is trying to make), Critical Annotations (answers the question "so what?"), and Question Annotations (students write their own questions about a significant part of the passage they are pondering).

Directions:

1. Tell students that you will be demonstrating a study strategy that they can use as they read textbook material and learn content information. To demo REAP, use an example from your content area (Matter) or the following example.

2. Identify a passage that you want students to read. Tell them to read the passage independently. After they read, tell students to identify main points and restate them in their own words. The following is an example of a textbook passage and an encoded message based on that passage. Write the passage and message on the chalkboard or an overhead transparency.

Investing in Savings Accounts

When you invest your money in savings accounts, the money is essentially risk-free; Even though banks may fail, as long as your investment in a bank is insured by either the Federal Deposit Insurance Corporation (FDIC) or the Federal Savings and Loan Insurance Corporation (FSLIC), your savings are risk-free. Banks savings accounts are virtually risk-free; however, money invested in banks does not return a high rate of interest.

Encoded Message

This paragraph is about investing in savings accounts. When you invest in savings accounts your money will note accrue much interest, but it will be safe.

3. Hand out note cards to students. After students have practiced encoding or restating the main points of the paragraph, have them write their statements on the cards. Tell them there can be many different ways to write a summary.

4. Divide the students into groups of three or four. Have students share their summaries with each other. Have them ponder, or think about, the different messages represented by the group.

5. Explain that there are four main types of annotations: summary annotations, thesis annotations, critical annotations, and question annotations. Write an example of each type of annotation on the chalkboard or an overhead transparency. Use examples from your content area or the examples that follow. Have the students identify the types of annotations they have written in their summaries. Then remind the students to use the REAP strategy as they study content information.

Examples of Annotations:

REAP Annotations

Summary Annotation (multiple ideas)
Money invested in banks is insured, so it is virtually risk-free.

Thesis Annotation (author's main point)
Investing money in banks has low risks and low returns.

Critical Annotation (interjected opinions)
Investing money in banks has low risks and low returns. I don't think money that is not needed to pay bills should be invested in banks. The low risks don't compensate for the low returns.

Question Annotation (questioning)
I thought that there was a ceiling on the amount of money that is insured by the banks. Are all savings entirely insured?

Activity 4: Organizing with Databases

Using a database is an excellent way to organize information when researching information that was collected from multiple sources. A database is a collection of information that can be organized for searching and retrieving information in a variety of ways. Students can actually design and build their own electronic databases with programs such as ClarisWorks (Apple), FoxPro (Microsoft), and FilMaker Pro (Claris). Great activities for gifted students to take it that one step further!

Directions:

1. Tell students that even though they have collected a great deal of information from reading their sources, they need to organize it before they can write a report. Explain that data can be organized in many ways and that students need to decide how they want their data organized.
2. Model how a researcher would read data and decide on categories for inputting the data in database. Use an example from your content area (Matter) or use the example that follows.

One of the research questions we have been considering, based on our textbook, is careers in health occupations. Several sources, both print and nonprint, were used to find the information. A partial list of the information is contained in the following chart.

Health Careers

Medical Practitioners	**Medical Records Personnel**	**Rehabilitation Occupations**
Treat patients	Keep records	Work with patients
Diagnose illness	Office jobs	Hands-on work
Work in offices or hospitals	Work in offices or hospitals	Work in hospitals or homes
Need M.D.	Various positions	Need special training

3. Discuss ways data could be organized into a database. In this example, one of the categories could be the education needed for a career. Another might be the location of the job.
4. Tell students that the data can be accessed in many different ways. Students should read their own data and come up with ways it could be organized and categorized. Then students should input their data.
5. Explain that the way data are retrieved from the database depends on the research question that is asked. Have students pose questions that can be answered from their data.

Activity 5: Dialectical Journal

Another method of recording information is to use a dialectical journal. A dialectical journal is a type of two-column journal where information from texts is written on the left side of the page and personal responses are written on the right. Poorman and Wright (2000) recommend this tool for students doing research.

Directions:

1. Explain to students that research papers include two types of writing: information from many sources and personal opinions. Students may not realize they can include their opinions in their research paper writing.
2. Ask students how they currently take notes.
3. Tell students you want to show them a new method of note-taking, called dialectical journals. Explain that they are a two-column type of note-taking where the writer copies short excerpts from a source on the left side of the paper and then writes a personal response to it on the right.
4. Explain to students that when they are writing information from sources, they might record summaries, quotations, interesting words or phrases, key information, or questions. These should be on the left.
5. Then they can record their personal responses on the right such as comments, thoughts, concerns, reflections and answers to questions.

Example:

Dialectical Journals	
Text on the Left (Source)	**Response on the Right**
Summaries	Your comments
Quotations	Your thoughts
Interesting words or phrases	Connections
Key information	Reflections
Questions	Answers to questions

Activity 6: Zooming In and Zooming Out

Struggling readers often need strategies to help them read text more closely and to learn new concepts. One strategy that helps all readers, especially struggling readers, read more closely yet learn how concepts fit in a larger concept is a strategy called Zooming In and Zooming Out (Harmon & Hedrick, 2001). This technique is a map that helps students think about concepts they are reading in content area texts.

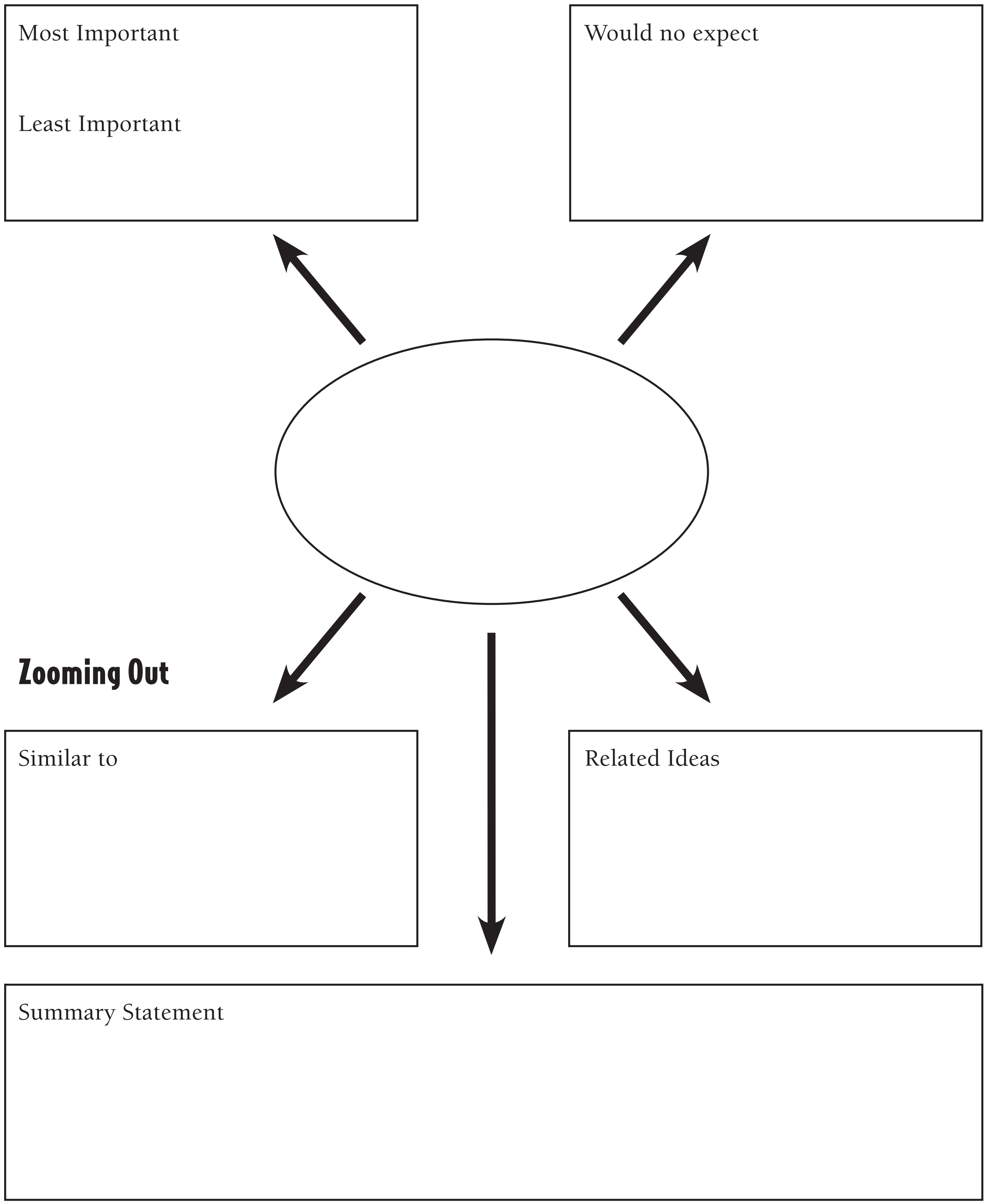
Directions:

1. Identify a passage that contains a concept that is crucial to learning a larger topic.
2. Make a transparency of the example of Zooming In and Zooming Out or create one of your own.
3. Tell students that they will be learning a new strategy that helps them understand text more deeply. Explain that they will need to think about meanings of a new term as it relates to their reading but also as it relates to a larger topic.
4. Divide the class into groups of three or four. Give a blank copy of the graphic organizer to each group.
5. Have students write the term in the center.
6. Have students read the passage and find three or more important facts about the term and two or more facts of lesser importance. Explain to students that as they are searching for facts they are zooming in on the term.
7. Discus with the class the facts stated by each group. As the class begins to understand the term, ask them what they would NOT expect from the term. List these on the right of the graphic organizer.
8. Then tell the class they need to think about the term in a larger sense: that they need to zoom out. Have the groups of students come up with ideas of what the term is similar to and have them list these on the graphic organizer. These ideas will be on the zooming out part of the graphic organizer.
9. Tell the students they should now have a good concept of what the term does and does not mean. They should now be able to generate a summary statement at the bottom of their graphic organizer.
10. Continue to use this strategy in a scaffolding way helping students to become more independent with it. It is always a good strategy to use at the beginning of a new topic of study.

Example:

See graphic organizer on next page:

Zooming In


Most Important
Least Important
Would no expect
Zooming Out
Similar to
Related Ideas
Summary Statement

Activity 7: Noting, Interacting, Prioritizing, Summarizing (NIPS)

NIPS (Herrell & Jordan, 2002) is a small group strategy that helps struggling readers comprehend informational text by combining several important reading and study strategies into one. Although NIPS is a valuable strategy for all students, it's especially useful for readers who have a difficult time understanding how the reading process works in its entirety.

Directions:

1. Tells students that you will be showing them a new strategy that is actually made up of four other strategies that are very useful when reading content area texts.
2. Write NIPS in a vertical line on the chalkboard or on an overhead transparency as is shown below.

   N = Note-taking
   I = Interacting
   P = Prioritizing
   S = Summarizing

4. Give students a passage of text from a content area text. They should read silently and take notes.
5. When finished reading, divide the class into groups of three or four and have them share their notes. Encourage them to add to their notes as their understanding becomes clearer.
6. After sharing is complete, pass out NIPS sheets.
7. Explain to students that they first need to prioritize the information they learned. Explain that this means to put the information in order of importance. Encourage the students to work together to do this.
8. The final step is to summarize the text. Explain that summarization means to provide a short synopsis of what they have learned. They should develop a group summary of the NIPS sheet.
9. Invite groups to share their lists of prioritized notes and summaries. As they share, encourage the class to modify their own notes as their understanding increases.

Example:

See NIPS sheet on next page.

Name ______________________________ Date ______________________________

NIPS

N = Note-taking I = Interacting P = Prioritizing S = Summarizing

List of Priorities

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________

Summarization

____

____

____

____

____

____

From Susan Davis Lenski, Mary Ann Wham, and Jerry L. Johns, *Reading & learning Strategies: Middle Grades through High School, 2nd Edition. Copyright 2003.*

Analyze It and Sell It!

Name of Activity: ______________________________

Main Purpose of Activity: ______________________________

Describe how it works: ______________________________

____

____

____

What types of text/content would it be most suited for? ______________________________

____

Is it flexible? Yes or No? Why? ______________________________

____

Rate its Effectiveness: (1 = Terrible! – 10 = So great, I'll use it weekly!)

1 2 3 4 5 6 7 8 9 10

Analyze It and Sell It!

Name of Activity: ______________________________

Main Purpose of Activity: ______________________________

Describe how it works: ______________________________

____

____

____

What types of text/content would it be most suited for? ______________________________

____

Is it flexible? Yes or No? Why? ______________________________

____

Rate its Effectiveness: (1 = Terrible! – 10 = So great, I'll use it weekly!)

1 2 3 4 5 6 7 8 9 10

Informational Text Activities Summary Sheet

These ideas and activities were summarized from the book: Reading and Learning Strategies: Middle Grades through High School by Lenski, Wham, and Johns. ISBN: 0-7872-8880-2. Page numbers for each activity are listed in parenthesis.

Activity 1: (REST) Record-Edit-Synthesize-Think (267)

Morgan, Meeks, Schollart, and Paul came up with a brilliant notetaking strategy in 1986 called REST. This strategy integrates textbooks, readings, lectures and class discussions. When students use REST, they record what they have read, edit those notes by deleting irrelevant material and condensing them, further refine notes by recording information stressed both in class lecture and the text and finally think about the notes while studying and learning. REST can be used when teachers assign reading before a class discussion or the other way around.
My notes:

Activity 2: Cornell Note-taking (271)

Cornell note-taking (Pauk, 1974) is similar to REST in that it is a two-column note-taking strategy. With Cornell note-taking, notes from textbook reading or class discussions are written on the right side of the page, and key words that organize the text are written on the right. This is a great strategy for topics organized into main ideas and details.
My notes:

Activity 3: (REAP) Read-Encode-Annotate-Ponder (274)

Annotative notes are at the heart of the REAP strategy (Eanet & Manzo, 1976). During the process, students will READ text, ENCODE the message by translating the information into their own words, ANNOTATE or write their messages in their notes, and PONDER the messages they have written. Critical to this activity is the different types of ANNOTATIONS students make in their notes. There are Summary Annotations (condenses the ideas into one or two statements), Thesis Annotations (states the main point the author is trying to make), Critical Annotations (answers the question "so what?"), and Question Annotations (students write their own questions about a significant part of the passage they are pondering).
My notes:

Activity 4: Organizing with Databases (352)

Using a database is an excellent way to organize information when researching information that was collected from multiple sources. A database is a collection of information that can be organized for searching and retrieving information in a variety of ways. Students can actually design and build their own electronic databases with programs such as ClarisWorks (Apple), FoxPro (Microsoft), and FileMaker Pro (Claris). These are great activities for gifted students to take it that one step further!
My notes:

Activity 5: Dialectical Journal (359)

Another method of recording information is to use a dialectical journal. A dialectical journal is a type of two-column journal where information from texts is written on the left side of the page and personal responses are written on the right. Poorman and Wright (2000) recommend this tool for students doing research.
My notes:

Activity 6: Zooming In and Zooming Out (396)

Struggling readers often need strategies to help them read text more closely and to learn new concepts. One strategy that helps all readers, especially struggling readers, read more closely yet learn how concepts fit in a larger concept is a strategy called Zooming In and Zooming Out (Harmon & Hedrick, 2001). This technique is a map that helps students think about concepts they are reading in content area texts.
My notes:

Activity 7: Noting, Interacting, Prioritizing, Summarizing (NIPS) (399)

NIPS (Herrell & Jordan, 2002) is a small group strategy that helps struggling readers comprehend informational text by combining several important reading and study strategies into one. Although NIPS is a valuable strategy for all students, it's especially useful for readers who have a difficult time understanding how the reading process works in its entirety.
My notes:

I Am an Ice Cube Rubric

I am an Ice Cube

	Poor 1 pts	Fair 2 pts	Good 3 pts	Excellent 4 pts
Ideas	Poor Shows little evidence of planning or creativity	Fair Shows some evidence of planning and/ or creativity	Good Planning completed using graphic organizers and creativity evident	Excellent Excellent use of graphic organizers and creative ideas
Science Concepts	Poor No understanding of concept is present	Fair Shows one state of water using correct science terms	Good Shows two states of water using correct science terms	Excellent Shows all three states of water using correct science terms
Organization	Poor Poorly organized. Does not demonstrate an understanding of the changes of state or states of matter.	Fair Shows some organization. Demonstrates some understanding of the changes of state or states of matter.	Good Organization evident. Demonstrates an understanding of the changes of state and states of matter.	Excellent Extremely well organized. Demonstrates a complete understanding of the changes of state and states of matter.
Presentation	Poor Messy, includes spelling errors.	Fair Some neatness evident, with few spelling errors.	Good Neatness evident, with 1-2 spelling errors.	Excellent Neat, no spelling errors.

Steps in Developing a Scoring Rubric

A. Make a preliminary decision on the dimensions of the product to be assessed. For a rubric assessing a science concept, some important things to focus on might include the following:

- Investigations
  - hypothesis
  - other data
  - observe
  - use equipment
  - draw inferences
- Concepts basic vocabulary of biological, physical & environmental sciences
- Applications
- Social, environmental implications and limitations
- Communication
  - language
  - problem/issue
  - observation
  - evidence
  - conclusion/interpretations

B. Look at some actual examples of student work to see if any important dimensions have been omitted. One technique that may be helpful is to sort examples of actual student work into three piles: the very best, the poorest, and those in between. With your colleagues, try to articulate what makes the good assignments good.

C. Write a definition for each dimension.

D. Develop a scale for describing the range of performances for each dimension. For each dimension, what characterizes the best possible performance of the task? This description will serve as the anchor for each of the dimensions by defining the highest score point on your rating scale. Using actual examples of student work as a guide will make this process much easier.

Planning a Vacation #1

Addition and Subtraction

My Weekend Vacation

I would like to take a weekend vacation down to Salt Lake City with my husband. Here is what I need you to figure out:

- We need to stay for two nights, so I need two nights lodging at a hotel.
- We need to eat one meal on Friday night, three meals on Saturday and three meals on Sunday.
- We need some entertainment.
- I don't want to spend more than $400.00 total.

CHOICES:

Hotels (Prices are per night. Remember that I need two nights. The stars tell you how nice of a hotel it is—the more stars, the nicer the place!)

Best Western	74.00 ***
Crystal Inn	65.00 ** ½ *
Super 8	49.00 **
Marriott	98.00 ****
Comfort Inn	59.00 ** ½ *

Entertainment (Prices are per event—it is the cost for both of us to do it.)

Shopping	??? – You decide how much we get to spend!
Movie	15.00
Broadway Show	100.00
Lagoon	50.00
Clark Planetarium	20.00
Hogle Zoo	25.00

Food (Prices are per meal—it is enough money for both of us to eat.)

Fast food	12.00 (Subway, McDonalds, etc.)
Mid-grade	20.00 (Chili's, Applebee's, Ruby Tuesday, etc.)
Expensive	30.00 (Olive Garden, Red Lobster, etc.)
High Class	40.00 (Café Pierpont, etc.)

Look on next page for an
example of what you should turn in!

Example of what you should turn in:

Hotel:

Friday night – Super 8	49.00
Saturday night – Super 8	49.00
TOTAL	98.00

Food:

Friday Dinner – mid-grade	20.00
Saturday Breakfast – fast	12.00
Lunch – fast	12.00
Dinner – fast	12.00
Sunday Breakfast – fast	12.00
Lunch – expensive	30.00
Dinner – fast	12.00
TOTAL	110.00

Entertainment:

Lagoon	50.00
Broadway Show	100.00
Movie	15.00
Zoo	25.00
TOTAL	190.00

GRAND TOTAL: 398.00

MY VACATION PLANS
According to ____________________:

Hotel:

Friday night – ________ ________

Saturday night – ________ ________

TOTAL ________ ________

Food:

Friday Dinner – ________ ________

Sat. Breakfast – ________ ________

Lunch – ________ ________

Dinner – ________ ________

Sun. Breakfast – ________ ________

Lunch – ________ ________

Dinner – ________ ________

TOTAL ________ ________

Entertainment:

____________________ ________

____________________ ________

____________________ ________

____________________ ________

____________________ ________

TOTAL ________

GRAND TOTAL: ________

Planning a Vacation #2

Addition, Subtraction and Decimals

My Weekend Vacation

I would like to take a weekend vacation down to Salt Lake City with my husband. Here is what I need you to figure out:

- We need to stay for two nights, so I need two nights lodging at a hotel.
- We need to eat one meal on Friday night, three meals on Saturday and three meals on Sunday.
- We need some entertainment.
- I don't want to spend more than $400.00 total.

CHOICES:

Hotels (Prices are per night. Remember that I need two nights. The stars tell you how nice of a hotel it is—the more stars, the nicer the place!)

Best Western	74.50 ***
Crystal Inn	65.85 ** ½ *
Super 8	49.25 **
Marriott	98.99 ****
Comfort Inn	59.30 ** ½ *

Entertainment (Prices are per event—it is the cost for both of us to do it.)

Shopping	??? – You decide how much we get to spend!
Movie	15.75
Broadway Show	100.20
Lagoon	50.05
Clark Planetarium	20.34
Hogle Zoo	25.19

Food (Prices are per meal—it is enough money for both of us to eat.)

Fast food	12.06 (Subway, McDonalds, etc.)
Mid-grade	20.21 (Chili's, Applebee's, Ruby Tuesday, etc.)
Expensive	30.09 (Olive Garden, Red Lobster, etc.)
High Class	40.78 (Café Pierpont, etc.)

Look on next page for an
Example of what you should turn in!

Example of what you should turn in:

Hotel:	
Friday night – Super 8	49.25
Saturday night – Super 8	49.25
TOTAL	98.50
Food:	
Friday Dinner – mid-grade	20.21
Saturday Breakfast – fast	12.06
Lunch – fast	12.06
Dinner – fast	12.06
Sunday Breakfast – fast	12.06
Lunch – expensive	30.09
Dinner – fast	12.06
TOTAL	110.60
Entertainment:	
Lagoon	50.05
Broadway Show	100.20
Movie	15.75
Zoo	25.19
TOTAL	190.19
GRAND TOTAL:	399.29

MY VACATION PLANS
According to ______________________:

Hotel:		
Friday night –	________	________
Saturday night –	________	________
TOTAL	________	________
Food:		
Friday Dinner –	________	________
Sat. Breakfast –	________	________
Lunch –	________	________
Dinner –	________	________
Sun. Breakfast –	________	________
Lunch –	________	________
Dinner –	________	________
TOTAL	________	________
Entertainment:		
________________		________
________________		________
________________		________
________________		________
________________		________
TOTAL		________
GRAND TOTAL:		________

Planning a Vacation #3

Addition, Subtraction, Multiplication with Decimals

My Weekend Vacation

I would like to take a weekend vacation down to Salt Lake City with my husband and our two kids. Here is what I need you to figure out:

- We need to stay for two nights, so I need two nights lodging at a hotel.
- We need to eat one meal on Friday night, three meals on Saturday and three meals on Sunday.
- We need some entertainment.
- I don't want to spend more than $600.00 total.

CHOICES:

Hotels (Prices are per night. Remember that I need two nights. The stars tell you how nice of a hotel it is—the more stars, the nicer the place!)

Best Western	74.50 ***
Crystal Inn	65.85 ** ½ *
Super 8	49.25 **
Marriott	98.99 ****
Comfort Inn	59.30 ** ½ *

Entertainment (Prices are per event, per person—it is the cost for ONE of us to do it. You will need to do some multiplication to figure out how much it costs for all of us to do it!)

Shopping	??? – You decide how much we get to spend!
Movie	7.75
Broadway Show	48.20
Lagoon	39.95
Clark Planetarium	12.34
Hogle Zoo	17.49

Food (Prices are per meal, per person. Again there are FOUR of us eating at each meal. Figure accordingly! Hint: 4xeach meal price!)

Fast food	5.95 (Subway, McDonalds, etc.)
Mid-grade	11.21 (Chili's, Applebee's, Ruby Tuesday, etc.)
Expensive	16.09 (Olive Garden, Red Lobster, etc.)
High Class	21.78 (Rodizio Grill, etc.)

Look on next page for an
example of what you should turn in!

Example of what you should turn in:

Hotel:

Friday night – Super 8	49.25
Saturday night – Super 8	49.25
TOTAL	98.50

Food:

Friday Dinner – mid-grade	44.84
Saturday Breakfast – fast	23.80
Lunch – fast	23.80
Dinner – fast	23.80
Sunday Breakfast – fast	23.80
Lunch – expensive	64.36
Dinner – fast	23.80
TOTAL	228.20

Entertainment:

Lagoon	159.80
Broadway Show	192.80
Movie	31.00
Zoo	69.96
TOTAL	453.56

GRAND TOTAL: 780.26

MY VACATION PLANS

According to ______________________:

Hotel:

Friday night –	________	________
Saturday night –	________	________
TOTAL	________	________

Food:

Friday Dinner –	________	________
Sat. Breakfast –	________	________
Lunch –	________	________
Dinner –	________	________
Sun. Breakfast –	________	________
Lunch –	________	________
Dinner –	________	________
TOTAL	________	________

Entertainment:

____________________	________
____________________	________
____________________	________
____________________	________
____________________	________
TOTAL	________

GRAND TOTAL: ________

4 Square

(Vocabulary Graphic Organizer)

Important Characteristics	Nonessential Characteristics
Examples	Not an Example of ___________

Science I-2&3

Activities

Nature of Matter

Boot Reer Root Beer

Standard I:
Students will understand that chemical and physical changes occur in matter.

Objective 2:
Evaluate evidence that indicates a physical change has occurred.

Objective 3:
Investigate evidence for changes in matter that occur during a chemical reaction.

Intended Learning Outcomes:
1. Use science process and thinking skills.

Content Connections:
Science I-3; Dry ice versus yeast

Science Standard I

Objective 2&3

Connections

Background Information

A physical change involves the changes that can be observed without changing the identity of substances. A chemical change is a process in which reactants are changed into one or more different products. A chemical change occurs whenever compounds are formed or decomposed. During this reaction, there is a rearrangement of atoms that makes or breaks chemical bonds. This change is usually not reversible.

Another way in which the distinction between chemical and physical changes is often expressed is to state that only chemical reactions involve the rearrangement of atoms within the molecule, which leads to the creation of a new molecule (new substance). Physical change does not create anything new; there is no change in the identity of the material (substance).

Changes in state but not chemical composition are not considered chemical changes. For example, while boiling water involves a change in temperature and the release of a gas (water vapor), a chemical change did not take place.

Research Basis

Maryland State Dept. of Education, Baltimore Div. of Instruction (1988). *Better Thinking and Learning: Building Effective Teaching through Educational Research.* 1-98.

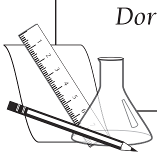
Instruction in 30 program areas, this paper is designed as a resource to assist teachers in expanding and refining teaching strategies. Topics included in the article include: activating prior knowledge, cooperative learning, critical thinking, graphic organizers, and metacognitive strategies.

Bathajthy, Ernest. (1988). From Metacognition to Whole Language: The Spectrum of Literacy in Elementary School Science. 26p.

This article considers the integration of reading and writing into elementary science. The article discusses the use of graphic organizers for teaching text structure, and the use of semantic feature analysis for teaching vocabulary concepts.

Materials

- ❑ *Physical/Chemical Change Rhyme*
- ❑ *Question/Prediction Chart*
- ❑ *Compare/Contrast*
- ❑ *Yeast Root Beer Recipe*
- ❑ Dry Ice Root Beer Recipe
- ❑ *Dry Ice Facts*
- ❑ Homemade root beer kit
- ❑ Root beet extract
- ❑ Sugar
- ❑ Water
- ❑ Dry yeast
- ❑ Dry ice
- ❑ Digital Scale
- ❑ Gloves
- ❑ 2 Empty 2-liter bottle for each group (cleaned and sanitized)
- ❑ Measuring cups
- ❑ Measuring spoons
- ❑ *The Root Beer Book: A Celebration of America's Best-Loved Soft Drink*
- ❑ *Root Beer Lady: The Dorothy Molter Story*



Invitation to Learn

Which Soda Pop Contains the Most Fizz?

In this activity the class will be split up into five or six different groups. Each group will be given a different brand 24 oz. bottle of soda pop. The groups will predict which soda has the most fizz and tell why they think that. The groups will be instructed to equally disperse about ½ of their bottle to the members of their group using small cups. As the students drink their soda, instruct them to think about descriptive words to describe how the soda pop tastes. The students will write these words on 3x5 cards. The groups will then take the remainder of their soda in the bottle and put a balloon over the opening. Have the students will take turns shaking the bottle lightly. The balloon will begin to fill with carbon dioxide. Then, have the groups will then take the carbon dioxide filled balloons and tie them off. The groups measure their balloons on the scale provided to see how much carbon dioxide was released from their soda. The groups will then compare their findings.

Instructional Procedures

1. Hand out the *Dry Ice Root Beer Recipe*. Read through the recipe with the class. (Because handling dry ice can be dangerous I have chosen to make the root beer with the class assisting me.) Hand out the *Physical/chemical Change Rhymes*. Point out that

in the following recipe a physical change will be used to add fizz to the root beer.

2. As you follow the recipe, point out to the class some facts about dry ice. Hand out *Dry Ice Facts* and talk about some of the things dry ice is used for, how it is manufactured, and what it is made of.
3. When finished, put dry ice in the root beer and have the students observe the effect. Discuss sublimation. Sublimation is the change from solid to gas while at no point becoming a liquid. When you place dry ice into some warm or hot water, clouds of white fog are created. This white fog is not the CO_2 gas, but rather it is condensed water vapor mixed in with the invisible CO_2. Also discuss that the carbon dioxide is mixing and attaching to the liquid root beer mixture.
4. Ask the class: What type of a change is occurring to the root beer mixture? A physical change is occurring. This is because no new substances are being made, and we can easily reverse the change. The carbon dioxide existed as a solid before we placed it in the root beer and it exists in a gaseous form to create fizz in our root beer.
5. As the dry ice sublimates in the root beer (10-15 min), take this time to use some of your leftover dry ice chunks to do a couple of experiments.

Popping Film Cans

A fun (and often wild) activity vividly demonstrates the sublimation process. Place a piece of dry ice into a plastic 35mm film container - the kind that has the snap-on cap. Then wait. The cap will pop off, and sometimes fly several meters. The clear Fuji brand containers shoot farther than the gray and black Kodak type. Warn anyone performing this experiment not to aim for anyone's eyes.

Singing Spoon

Press a warm spoon firmly against a chunk of dry ice. The spoon will scream loudly as the heat of the spoon causes the dry ice to instantly turn to gas where the two make contact. The pressure of this gas pushes the spoon away from the dry ice, and without contact, the dry ice stops sublimating. The spoon falls back into contact again, and the cycle repeats. This all happens so quickly that the spoon vibrates, causing the singing sound you hear.

Fog Effects

When you place dry ice into some warm or hot water, clouds of white fog are created. This white fog is not the CO_2 gas, but rather it is condensed water vapor, mixed in with the invisible CO_2. The extreme cold causes the water vapor to condense into clouds. The fog is heavy, being carried by the CO_2, and will settle to the bottom of a container, and can be poured.

6. In this last step, the students will taste the root beer and write down some of the characteristics of the root beer on the *Venn Diagram*. (Focus on descriptive words and the fizz of the root beer. I like to ask the class to rate the fizz on a 1-10 scale.)
7. Hand out the *Yeast Root Beer Recipe* to the groups. (Each of these recipes are different from one another.) Read through the recipe with the class, and distribute the tools needed to make this type of root beer. It should be explained to the students that the recipes are different to allow comparing and contrasting. Discuss with the class that zymology is the study of fermentation. Fermentation is the chemical conversion of carbohydrates (sugars) into alcohols or acids. Basically, the yeast eats the sugar and a chemical change occurs, creating carbon dioxide. The students will then fill out their *Question/ Prediction* handout. The students will try to rate which root beer recipe will have the most fizz.
8. I have found it more exciting to let the students follow the recipe and make it themselves. Sometimes the students make errors or alterations to the recipe and the outcome is valuable in discussing the scientific process. Make sure to rotate through the class offering help as the class follows their recipe.
9. After the groups have made their root beer, make sure they label their bottles. Then put the bottles somewhere int the sun where they will not be disturbed for at least 4 hours. Then chill the bottles overnight.
10. In this last step, have the students taste test their root beer. Make sure the students get a chance to taste each of the root beer recipes. Using the Venn Diagram, have the class describe

how the recipes are the same and how they are different. Focus on descriptive words and similes and metaphors.

Assessment Suggestions

- Rubric: Were the objectives reached? Was Root Beer Created?
- Non-Fiction Vocab-u-Write
- K.W.L.

Curriculum Extensions/Adaptations/ Integration

- Explore zymology on the internet/PowerPoint. What types of jobs use zymology and what types of products are made using zymology? Provide ideas for extension for advanced learners.
- Explain and predict the effects that would occur if various changes were made to the root beer recipes
- Supply students with vocabulary and definitions.
- Extend time limit for students with special needs.
- Use pictures in a Power Point presentation to show the steps of the recipe.
- Include ideas for integration for other curricular areas Have the students describe what other things taste like using similes and metaphors.

Family Connections

- Have the students take a copy of *Root Beer Lady: The Dorothy Molter Story* home to read with their parents.
- Have students make a list with their parents of household products that have yeast/carbon dioxide in them. Then have them write what characteristics the yeast/carbon dioxide has upon the products.

Additional Resources

Books

The Root Beer Book: A Celebration of America's Best-Loved Soft Drink, by Laura E. Quarantiello; ISBN 0936653787

A Flying Needs Lots of Root Beer, by Charles M. Schulz; ISBN 0694010464

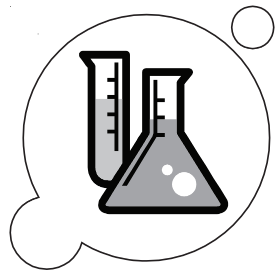
Root Beer Lady: The Dorothy Molter Story, by Bob Cary; ISBN 0938586688

Web sites

http://www.root-beer.org/

http://www.geocities.com/NapaValley/1140/

Physical/Chemical Change Rhyme



A Physical Change changes how things look,

Like tearing the pages of a book,

Or freezing a liquid, like water to ice,

Or painting a house to make it look nice.

A Chemical Change has come to pass

If you can see a new solid, liquid, or gas.

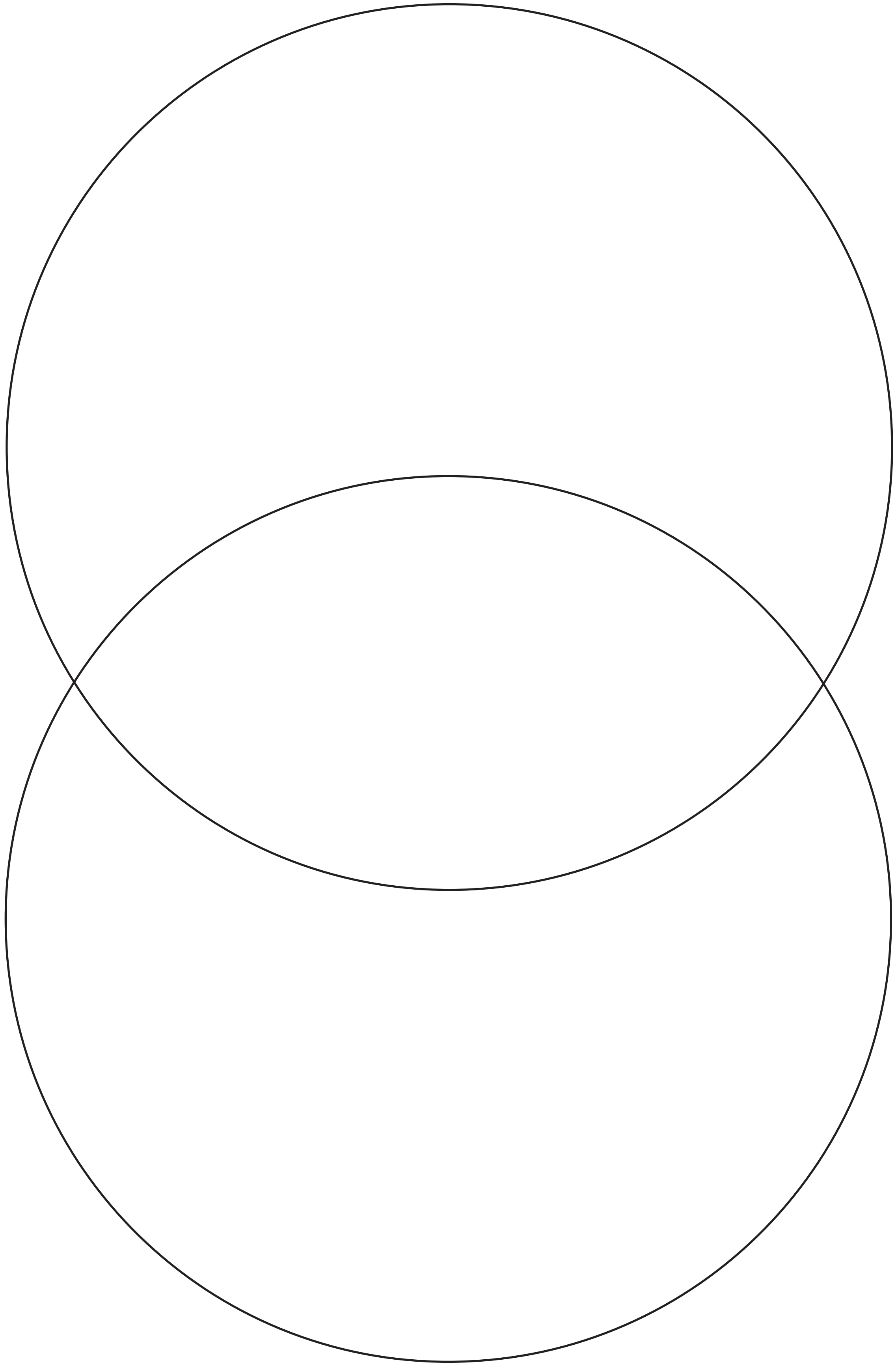
The color may change or the energy too.

A chemical change makes something new.

Question/Prediction Chart

Question	Prediction

Venn Diagram



Yeast Root Beer Recipe

Ingredients

- 1 teaspoon dry yeast
- 1/2 cup warm water
- 2 cups granulated sugar
- 1 quart hot water
- 4 teaspoons root beer extract
- 3 quarts warm water

Directions

1. Dissolve yeast in 1/2 cup warm water.
2. Dissolve sugar in 1 quart of hot water.
3. In a gallon jar, mix yeast and sugar mixtures.
4. Add the root beer extract and 3 quarts warm water. Mix well.
5. Cover jar and set in sun for 4-hours.
6. Chill and let brew for a day.

Yeast Root Beer Recipe

Ingredients

- 1 teaspoon dry yeast
- 1/2 cup warm water
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- 1 quart hot water
- 4 teaspoons root beer extract
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Directions

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3. In a gallon jar, mix yeast and sugar mixtures.
4. Add the root beer extract and 3 quarts warm water. Mix well.
5. Cover jar and set in sun for 4-hours.
6. Chill and let brew for a day.

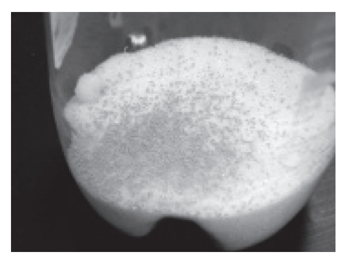
How to Make Root Beer

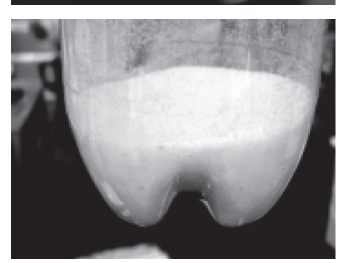
Making root beer is easy once you gather all the necessary supplies. It's a great family project and a way to teach the younger ones that not everything tasty comes from an aluminium can. And it's delicious, too!

Things You'll Need for Yeast Root Beer

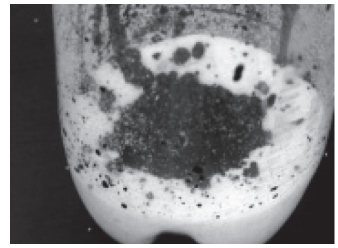
- clean 2 liter plastic soft drink bottle with cap
- funnel
- 1 cup measuring cup
- 1/4 tsp measuring spoon
- 1 Tbl measuring spoon
- cane (table) sugar [sucrose] (1 cup)
- Zatarain's Root Beer Extract (1 tablespoon)
- powdered baker's yeast (1/4 teaspoon) (Yeast for brewing would certainly work at least as well as baking yeast.)
- cold fresh water

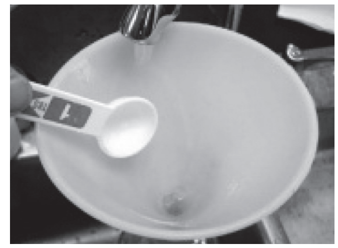
1. Using a clean bottle and a dry funnel, add the ingredients in sequence as stated in the steps that follow. First add a level cup of table sugar (or cane sugar). Adjust the amount to achieve the desired sweetness.
2. Measure out 1/4 teaspoon powdered baker's yeast and pour it in the funnel. The yeast should be fresh and active, and any brand that is available will work.
3. Shake well to make sure that the yeast grains are distributed evenly into the sugar.
4. Swirl the sugar/yeast mixture in the bottom of the bottle in order to make it concave and enable it to catch the extract in the middle.
5. Replace the funnel and add 1 Tbsp of root beer extract on top of the dry sugar. Notice how the extract sticks to the sugar. This will help dissolve the extract as seen in the next few steps.
6. Fill the bottle halfway with fresh cool tap water that has only a little chlorine. (Pour through the funnel and use this opportunity to rinse extract stuck to the funnel and





tablespoon.) Swirl to dissolve the ingredients.



7. Fill the bottle to the neck, this time with fresh water, leaving only about an inch (2.54cm) of head space. Securely screw the cap to seal the bottle. Invert repeatedly to thoroughly dissolve the contents.
8. Place the sealed bottle at room temperature for about three or four days until the bottle feels hard to a forceful squeeze. Then move it to a cool place (below 65 F (18 C)). Refrigerate overnight to thoroughly chill before serving. Crack the lid of the bottle just a little to release the pressure slowly.

Tips:

- There will be a sediment of yeast at the bottom of the bottle, so that the last bit of root beer will be turbid. Decant carefully if you wish to avoid this sediment.
- Fermentation has been used by mankind for thousands of years for raising bread, fermenting wine and brewing beer. The products of the fermentation of sugar by baker's yeast Saccharomyces cerevisiae (a fungus) are ethyl alcohol and carbon dioxide. Carbon dioxide causes bread to rise and gives effervescent drinks their bubbles. This action of yeast on sugar is used to 'carbonate' beverages, as in the addition of bubbles to champagne.
- Artificial sweetener cannot be used to replace the sugar. Sugar is required for yeast to generate carbon dioxide which carbonates the beverage. No sugar, no carbonation. You might experiment with less sugar, and add a substitute to make up for the lower sweetness, but it is not known just how little you can add and still get adequate carbonization.
- Use bottled water instead of tap.

Warnings:

- Do not leave the finished root beer in a warm place once the bottle feels hard. After a couple weeks or so at room temperature, especially in the summer when the temperature is high, enough pressure may build up to explode the bottle! There is no danger of this if the finished root beer is refrigerated. Move to a refrigerator overnight before opening.
- There might be alcohol in this home made soft drink. The alcoholic content which results from the fermentation of this root beer has been found, through testing, to be between 0.35 and 0.5 %. Comparing this to the 6% in many beers, it would require a person to drink about a gallon and a half (5.7 L) of this root beer to be equivalent to one 12 ounce (355 mL) beer. It can be said that this amount of alcohol is negligible, but for persons with metabolic problems who cannot metabolize alcohol properly, or religious prohibition against any alcohol, consumption should be limited or avoided. However, there are many high school biology labs who have made this beverage without any problems.

Dry Ice Root Beer

Prepare your class with a demonstration or class activity to show sublimation and/or solubility of a gas in a liquid. This activity is done as a demonstration!

Materials:

5 gallon container (those orange Rubbermaid ones with a spigot are perfect)
5 pounds sugar
5 gallons water
1 bottle root beer extract
5 pounds or so of dry ice

Procedure

Put water in container. If you can use cold water, that's great. Add sugar and extract. Mix well. This makes enough for about 200 3 oz. cups of root beer. At this point it would be a good idea to pour out enough root beer for one or two classes into a smaller container and carbonate the root beer for one or two classes at a time. You need about 1 pound of dry ice per gallon of root beer mix. When you are ready, add the dry ice to the root beer mixture. The students will enjoy watching it bubble, etc. and you can use the wait time to discuss sublimation and solubility of gas in a liquid. Serve the root beer in 3 oz.cups and have the students answer the following questions while they drink.

Suggested questions:

1. How do you know that the dry ice sublimes and doesn't go through the liquid phase first?
2. What is the gas that dry ice emits?
3. What would be another way to carbonate a drink?
4. You are drinking an acid in your cup. How did it become an acid?
5. Has this changed your attitude about acids? Explain your answer.

Alternate Plan: STUDENTS MAKE THEIR OWN INDIVIDUAL CUP OF Root beer SO THEY GET PRACTICE IN CONVERSIONS AND MEASURING AS WELL AS LEARNING ABOUT SUBLIMATION

Materials

7 gallon container (those orange 10 Gallon Rubbermaid ones with a spigot are perfect)
5 pounds sugar (if you don't have a container this large, just reduce the quantities proportionally)
5 gallons water
1 bottle root beer extract
5 pounds or so of dry ice
graduated cylinders
paper towel

3 oz cups (one per person)
balances
spoons or straws to stir with

Procedure

1. Mix water and root beer extract together in a five gallon container.
2. Give each student a 3 oz cup
3. Have students figure out how much root beer/water mixture they need to put in their cup. You can give them the following conversions:
   454 grams = 1 pound
   1 gallon = about 20,000 ml (or one liter =1,000ml, one quart is about 1 liter, one gallon = 4 quarts, 1 liter = 32 ounces if you're brave)
4. From the above conversions, students should be able to figure out that they need 93 ml of the water/root beer mixture, 10.7 grams of sugar, and 10.7 or so grams of dry ice.
5. Have students measure water/root beer mixture into their cup, measure the sugar, add to water mixture and stir, and then add dry ice to their cup.
6. After discussing sublimation and solubility of gas in a liquid, have students answer the following questions on their own paper.

Conclusion questions

1. How do you know that the dry ice sublimes and doesn't go through the liquid phase first?
2. What is the gas that dry ice emits?
3. What would be another way to carbonate a drink?
4. You are currently drinking an acid in your cup. How did it get that way?
5. Has this changed your attitude about acids? Explain your answer.

Safety concerns:

Teachers and students, be sure to keep all Chemical Safety Rules that are specified by your teacher and in all general laboratory experiences.

Dry Ice Facts

History

In 1835 the French chemist Charles Thilorier published the first account of dry ice. Upon opening the lid of a large cylinder containing liquid carbon dioxide he noted much of the carbon dioxide rapidly evaporated leaving solid dry ice in the container. Throughout the next 60 years, dry ice was observed and tested by scientists.

Manufacturing

1. Carbon dioxide is pressurized and refrigerated until it changes into its liquid form.
2. The pressure is reduced. When this occurs some liquid carbon dioxide vaporizes, and this causes a rapid lowering of temperature of the remaining liquid carbon dioxide. The extreme cold makes the liquid solidify into a snow-like consistency.
3. The snow-like solid carbon dioxide is compressed into either small pellets or larger blocks of dry ice.

Dry ice is typically produced in two standard forms, blocks and cylindrical pellets. A standard block is most common and is approximately 30 kg. These are commonly used in shipping, because they sublime slowly due to a relatively small surface area. Pellets are around 1 cm in diameter and can be bagged easily. This form is suited to small scale use, for example at grocery stores and laboratories. Dry ice is also inexpensive; it costs about US $2 per kilogram.

Applications

Dry ice is commonly used to package items that need to remain cold or frozen, such as ice cream, without the use of mechanical cooling. In medicine it is used to freeze warts to make removal easier. In the construction industry it is used to loosen floor tiles by shrinking and cracking them, as well as to freeze water in valveless pipes to allow repair. In laboratories, a slurry of dry ice in an organic solvent is a useful freezing mixture for cold chemical reactions.

Dry ice can also be used for making ice cream.

Dry ice is also used as a source of carbon dioxide. It can be used to carbonate water and other liquids such as root beer. It can be used as bait to trap mosquitoes and other insects

When dry ice is placed in water sublimation is accelerated, and low-sinking dense clouds of fog are created. This is used in fog machines at theaters and nightclubs for dramatic effects.

History of Root Beer

There's nothing quite like a frosty mug of creamy, real, old fashioned root beer. But where did this sweet beverage come from? Though the roots of root beer are so deep, they're more American than apple pie, there are varying theories about just who invented root beer and where it came to be.

FROM THE EARLY AMERICANS TO SHAKESPEARE

There are early historical documents in which Shakespeare is noted to have drank "small beers." This European brew, actually made from an early colonial American recipe, contained 2-12-percent alcohol, and was considered a light, social drink made from herbs, berries and bark. During American Colonial times, root beer was introduced along with other beverages like Birch Beer, Sarsparilla Beer, and Ginger Beer. Only root beer would emerge as a longtime favorite. There are even historical documents which show 18th century farm owners brewing an alcoholic version of root beer in backyard stills for family get-togethers, social events, and parties.

MEDICINAL ORIGINS

Most historians believe that the invention of an actual root beer recipe happened by pure accident, thanks in part to an inventive pharmacist, eager to create a miracle drug. Though people had been drinking an herbal home brewed variety for years, root beer was still just an experiment for the creative and inventive. In 1870, an unknown pharmacist toying with a handful of roots, berries and herbs, came up with a recipe for root beer which consisted of juniper, wintergreen, spikenard, pipsissewa, sarsaparilla, vanilla beans, hops, dog grass, birch bark and licorice. The original drink was quite medicinal in nature, tasting both bitter and sweet. Even though the pharmacist offered the drink to the public as a cure-all, it was never marketed or well-received.

HIRES COMPANY

Meanwhile, Charles Hires, also a pharmacist, was on his honeymoon around the same time when he discovered an herbal tea he simply could not part with. After taking the recipe of herbs, berries and roots home to Philadelphia with him, he began selling a packaged dry mixture to the public made from many of the same ingredients as the original herbal tea. Well received, Hires soon developed a liquid concentrate blended together from more than 25 herbs, berries and roots. The public loved the new drink and as a result, Hires introduced commercial root beer to the public in 1876 at the Philadelphia Centennial Exhibition. In no time, it became a popular drink of its day. By 1893, the Hires family sold bottled versions of their well-known brew, sealing their place in root beer history.

No matter which version of root beer history is true, one thing is for certain: Root beer is an original brew, predating colas and other popular sodas.

GOVERNMENT BAN

The key ingredient to root beer is sassafras root, which is what produces the tangy, thick brewed flavor that root beer is noted for. In 1960, the U.S. Food and Drug Administration banned the use of sassafras oil, labeling it a carcinogen. Root beer makers began experimenting with new and improved recipes, minus the sassafras oil, hoping to find a suitable tasting alternative. Not long after the ban, the root beer industry was saved when inventors discovered that sassafras could be used afterall, if treated first, to remove the oil.

WHAT IS IN ROOT BEER?

There's is no true authentic root beer recipe, since there are so many different combinations and brews. Over time, root beer has contained ingredients like allspice, birch bark, coriander seed, ginger and ginger root, hops, burdock root, dandelion root, guaiacum chips, spicewood, wild cherry bark and bitters, wintergreen and wintergreen oil, yellow dock, prickly ash bark and even, molasses.

Today, root beer is made from a mixture of flavorings, sweeteners and carbonation. Depending on the brew, bottler and manufacturer, root beer still contains a large number of herbs (burdock root, sarsaparilla root, yellow dock root, ginger root, juniper berries, wild cherry bark, birch bark, etc.), oils (anise, lemon, artificial wintergreen, etc.), sweeteners (sugar, molasses, corn sugar, fructose, asparatame, brown sugar, lactose, malt extract, etc.) and carbonation (yeast, artificial, forced carbonation.)

The Root Beer Book: A Celebration of America's Best-Loved Soft Drink, by Laura E. Quarantiello; ISBN: 0936653787

Math IV

Activities

Polygon Volume & Area

If the Shape Fits

Standard IV:
Students will determine area of polygons and surface area and volume of three-dimensional shapes.

Objective 1:
Determine the area of polygons and apply to real-world problems.

Intended Learning Outcomes:
2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.
4. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.

Content Connections:
Math I-6; Multiplying decimals.
Language Arts VIII-6; Produce informational text.

Math Standard IV

Objective 1

Connections

Background Information

This two-day activity involves the composition and decomposition of trapezoids and irregular polygons. A trapezoid is a quadrilateral with exactly one pair of parallel sides. An irregular polygon is a closed figure whose sides are not all the same length.

Before teaching this lesson, students need to know how to find the area of squares (b x h), rectangles (b x h), parallelograms (b x h), and triangles (½ b x h). They should also be familiar with using rulers to measure in centimeters.

Research Basis

Ball, D. (1991). What's all this talk about discourse? *Professional Standards for Teaching Mathematics*. National Council of Teachers of Mathematics, 1991.

Deborah Ball defines "discourse" as described by the NCTM Standards. A discussion from her classroom, along with entries from her teaching journal, illustrate how thoughtful discourse can be used to help students learn to discuss and understand mathematic concepts.

Bryant, V.A. (1992). Improving Mathematics Achievement of At-Risk and Targeted Students in Grades 4-6 Through the Use of Manipulatives. *ERIC* Source (ERIC #ED355107). Retrieved December 10, 2007, from http://eric.ed.gov.

This document presents a study designed to improve mathematics achievement in grades 4-6 through the use of manipulatives. The primary goal was to provide mathematics manipulatives that would assist in helping at-risk and targeted students. Results indicated improvement on test scores, report card grades, and use of mathematics manipulatives.

Materials

- ❑ *I Have, Who Has?* cards
- ❑ Metric rulers
- ❑ *Trapezoid 1*
- ❑ *Trapezoid 2*
- ❑ *Trapezoid 3*
- ❑ *Trapezoid Shapes 1*
- ❑ *Trapezoid Shapes 2*
- ❑ *Trapezoid Shapes 3*
- ❑ cm graph paper
- ❑ *Trapezoid Assessment*
- ❑ *Irregular Polygon Overhead*
- ❑ Overhead ruler
- ❑ *Irregular Polygons 1*
- ❑ *Irregular Polygons 2*
- ❑ *Irregular Polygons 3*
- ❑ *Irregular Polygons 4*
- ❑ *Irregular Polygon Assessment*

Invitation to Learn

Play *I Have, Who Has?* with your class. You may need to remind them how to find the area of squares, rectangles, parallelograms and triangles.

Instructional Procedures

Day One

1. Hand out *Trapezoid 1* and *Trapezoid Shapes 1* to one third of your students. Do the same thing with *Trapezoid 2* and *Trapezoid Shapes 2*, and then *Trapezoid 3* and *Trapezoid Shapes 3*.
2. Have students cut out the shapes on their *Trapezoid Shapes* pages.
3. Have them find which shapes fit together to make their trapezoid.
4. Once they know which shapes make their trapezoid, have them measure (with a ruler and using cm) the base and height of each of those shapes. Tell them to use their measurements to find the area of each shape.
5. After they have found the areas of their shapes, ask them how they could use the area of those shapes to find the area of their trapezoid.
6. Discuss ideas.
7. Have students figure out the area of their trapezoid.
8. In their journals, have students draw a trapezoid and describe how to find the area of it by dissecting it into familiar shapes.
9. Hand out cm graph paper to each student.
10. Have them create their own trapezoid using squares, rectangles and triangles.
11. Tell the students to figure out the area of their trapezoids.
12. Have students switch their trapezoids with a partner and find the area of the new trapezoid.
13. Have partners compare answers and discuss their findings.
14. Have students complete *Trapezoid Assessment*.

Day Two

1. On the overhead, show your students the *Irregular Polygon Overhead.* Ask students if they have any ideas of how to find the area of the polygon.
2. After the Day One activity, they should realize they can break the polygon into triangles, squares, rectangles or parallelograms. Then they can find the area of each shape, and then add all of the areas together. That will give them the area of the irregular polygon.
3. Have volunteers come to the overhead and demonstrate how they could break up the polygon into different shapes.
4. With an overhead ruler, demonstrate how to measure each shape using centimeters.
5. As a class, find the area of each shape, and then add the areas all together to get the area of the irregular polygon.
6. Hand out *Irregular Polygons 1* to ¼ of your students, do the same with *Irregular Polygons 2, Irregular Polygons 3,* and *Irregular Polygons 4*.
7. Have students draw lines to break their polygons into triangles, squares, rectangles, and parallelograms.
8. Have them measure (with a ruler and using centimeters) each shape, find its area, and then add them together to find the area of their irregular polygon. Write that area in their journal.
9. Have students cut up their polygon up into the new shapes they created.
10. Have them switch their shapes with a partner.
11. Have partners create a new irregular polygon with those shapes and glue it into their journals.
12. Measure each of the shapes, find its area, and then add them together to find the area of the new irregular polygon.
13. Have partners compare results. They should find that the area of the original polygon and the area of the new polygon are the same.
14. Discuss their findings. Even though the shape changed, the area remained the same.
15. In their journals, have students explain how they find the area of irregular polygons. Have them use the irregular polygon they glued into their journals as an example.
16. Have students complete the *Irregular Polygon Assessment*.

Assessment Suggestions

- Informal assessment includes observation of student work, class discussion and journals.
- *Trapezoid Assessment*
- *Irregular Polygon Assessment*

Curriculum Extensions/Adaptations/ Integration

- For students who have a difficult time using a ruler to measure, copy their trapezoid and irregular polygons on cm graph paper. This will be an easier way for them to find the area.
- Show students examples of floor plans for homes on the internet (or borrow some from a builder). Explain to the students that floor plans are just big irregular polygons, and in order for a contractor to figure out how much material is needed for the house, he/she has to find the area of that plan. Have students design the floor plan of their own dream house on cm graph paper.

Family Connections

- Have family help the students find the area of their dream house floor plan.
- Have students show someone in their family how to decompose a trapezoid or polygon into different shapes in order to find the area.
- Have students find the area of their own house.

Additional Resources

Books

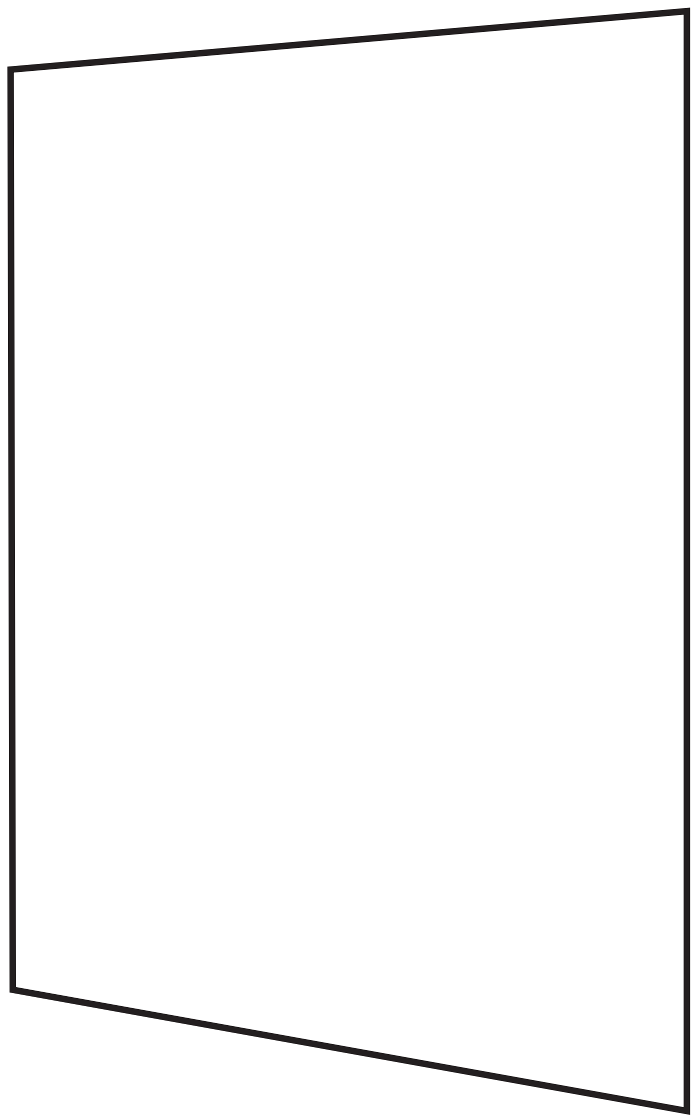
Math on Call, A Mathematics Handbook, by Great Source Education Group; ISBN 0-669-45770-1

I Have, Who Has?

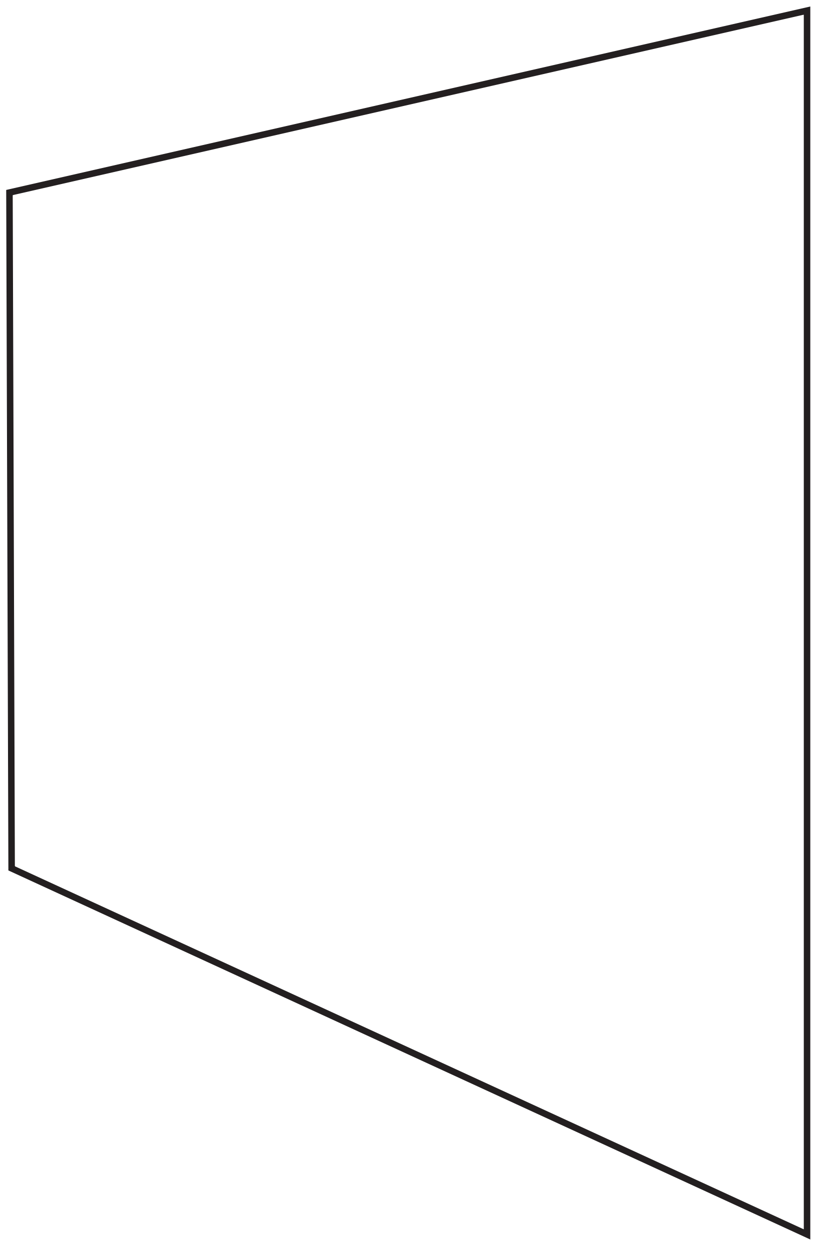
Who has a figure with four equal sides that has an area of 36 cm^2?	I have a square that has a length of 6 cm. Who has the area of a triangle with a height of 6 cm and a base of 5 cm?	I have a triangle with an area of 15 cm^2? Who has the area of a rectangle with a length of 8 cm and a width of 4 cm?
I have a rectangle with an area of 32 cm^2. Who has a rectangle with an area of 60 cm^2?	I have a rectangle with a length of 10 cm and a width of 6 cm. Who has a triangle with an area of 20 cm^2?	I have a triangle with a base of 8 cm and a height of 5 cm. Who has an area of a square with sides of 4 cm?
I have a square with an area of 16 cm^2. Who has a parallelogram with a base of 6 cm and a height of 4 cm?	I have a parallelogram with an area of 24 cm^2. Who has a triangle with a base of 5 cm and a height of 4 cm.	I have a triangle with an area of 10 cm^2. Who has a parallelogram with a base of 10 cm and a height of 4 cm?
I have a parallelogram with an area of 40 cm^2. Who has a square with an area of 9 cm^2?	I have a square with sides of 3 cm. Who has a rectangle with a length of 9 cm and a width of 5 cm?	I have a rectangle with an area of 45 cm^2. Who has a triangle with a base of 4 cm and a height of 9 cm?
I have a triangle with an area of 18 cm^2. Who has a parallelogram with a height of 4 cm and a base of 12 cm?	I have a parallelogram with an area of 48 cm^2. Who has a square with an area of 4 cm^2?	I have a square with sides of 2 cm. Who has a rectangle with a width of 4 cm and a length of 3 cm?
I have a rectangle with an area of 12 cm^2. Who has a parallelogram with an area of 8 cm^2?	I have a parallelogram with a base of 4 cm and a height of 2 cm. Who has a triangle with an area of 24 cm^2?	I have a triangle with a base of 12 cm and a height of 4 cm. Who has a square with sides of 5 cm?
I have a square with an area of 25 cm^2. Who has a rectangle with a length of 5 cm and a width of 3 cm?	I have a rectangle with an area of 15 cm^2. Who has a triangle with a base of 12 cm and a height of 5 cm.	I have a triangle with an area of 30 cm^2. Who has a parallelogram with a base of 9 cm and a height of 4 cm?

I have a parallelogram with an area of 36 cm². Who has a figure with four equal sides that has an area of 49 cm²?	I have a square that has a length of 7 cm. Who has an area of a triangle with a height of 10 cm and a base of 5 cm?	I have a triangle with an area of 25 cm²? Who has an area of a rectangle with a length of 10 cm and a width of 4 cm?
I have a rectangle with an area of 40 cm². Who has a rectangle with an area of 36 cm²?	I have a rectangle with a length of 12 cm and a width of 3 cm. Who has a triangle with an area of 40 cm²?	I have a triangle with a base of 16 cm and a height of 5 cm. Who has an area of a square with sides of 8 cm?
I have a square with an area of 64 cm². Who has a parallelogram with a base of 5 cm and a height of 4 cm?	I have a parallelogram with an area of 20 cm². Who has a triangle with a base of 6 cm and a height of 4 cm.	I have a triangle with an area of 12 cm². Who has a parallelogram with a base of 3 cm and a height of 4 cm?
I have a parallelogram with an area of 12 cm². Who has a square with an area of 81 cm²?	I have a square with sides of 9 cm. Who has a rectangle with a length of 10 cm and a width of 5 cm?	I have a rectangle with an area of 50 cm². Who has a triangle with a base of 6 cm and a height of 9 cm?
I have a triangle with an area of 27 cm². Who has a parallelogram with a height of 5 cm and a base of 12 cm?	I have a parallelogram with an area of 60 cm². Who has a square with an area of 100 cm²?	I have a square with sides of 10 cm. Who has a rectangle with a width of 4 cm and a length of 7 cm?
I have a rectangle with an area of 28 cm². Who has a parallelogram with an area of 6 cm²?	I have a parallelogram with a base of 3 cm and a height of 2 cm. Who has a triangle with an area of 5 cm²?	I have a triangle with a base of 2 cm and a height of 5 cm. Who has a square with sides of 11 cm?
I have a square with an area of 121 cm². Who has a rectangle with a length of 6 cm and a width of 9 cm?	I have a rectangle with an area of 54 cm². Who has a triangle with a base of 10 cm and a height of 9 cm.	I have a triangle with an area of 45 cm².

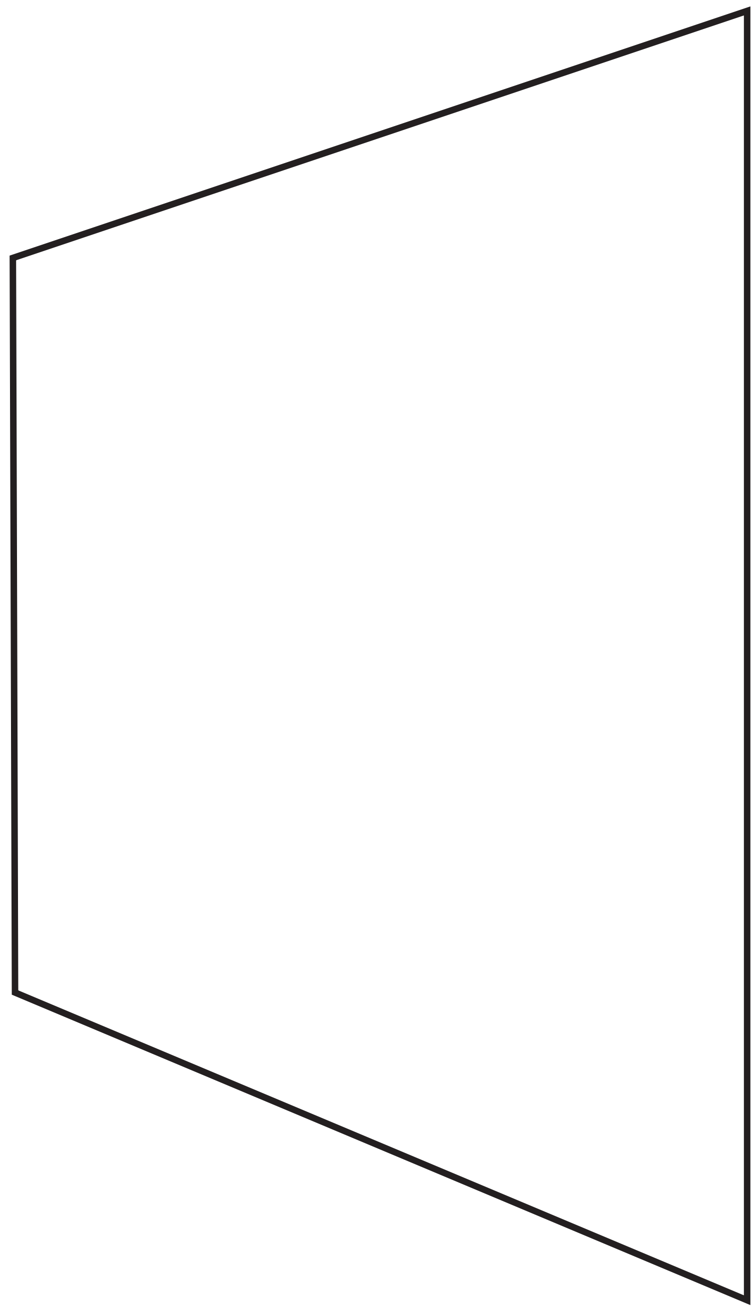
Trapezoid 1



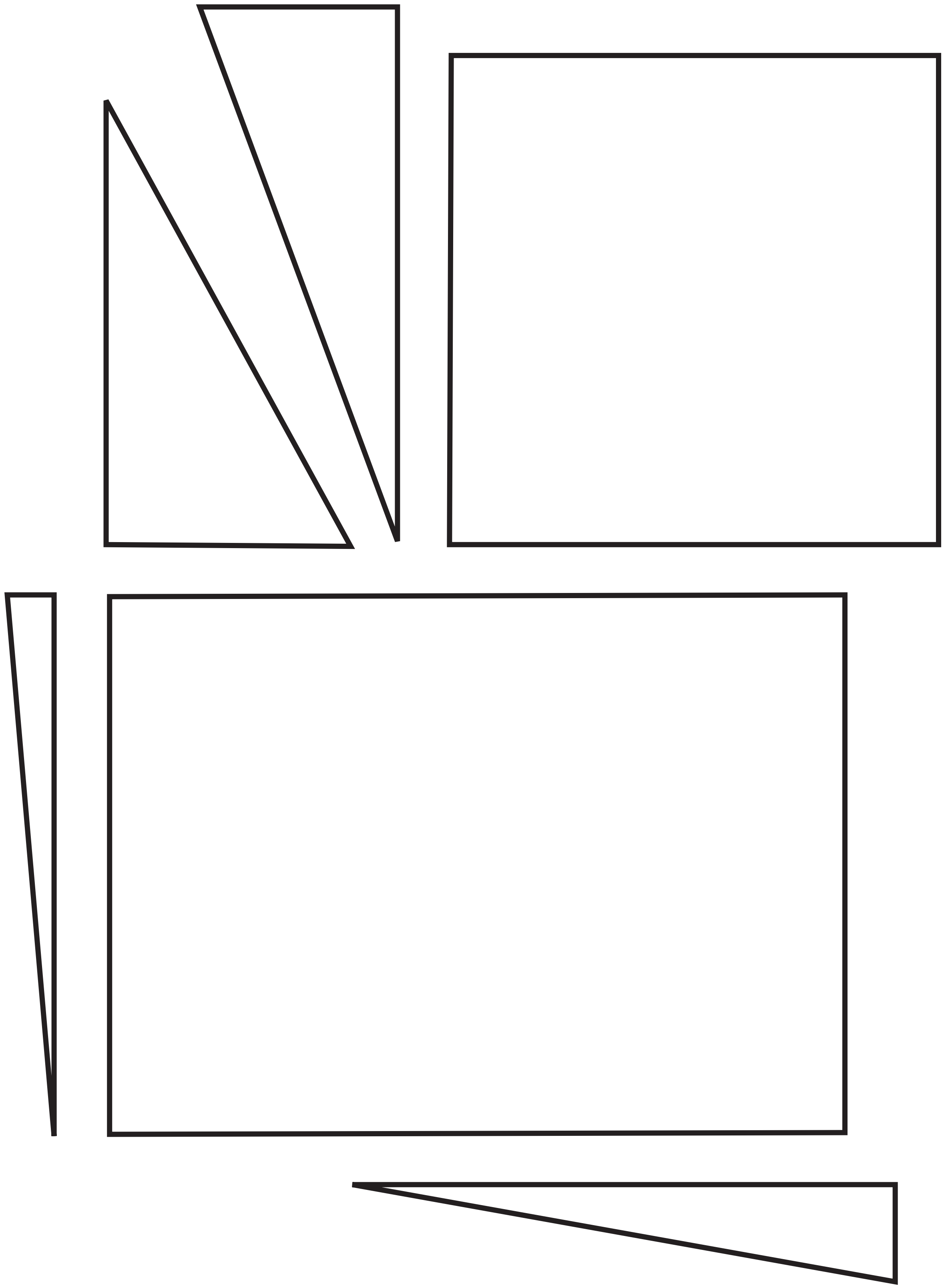
Trapezoid 2



Trapezoid 3



Trapezoid Shapes 1



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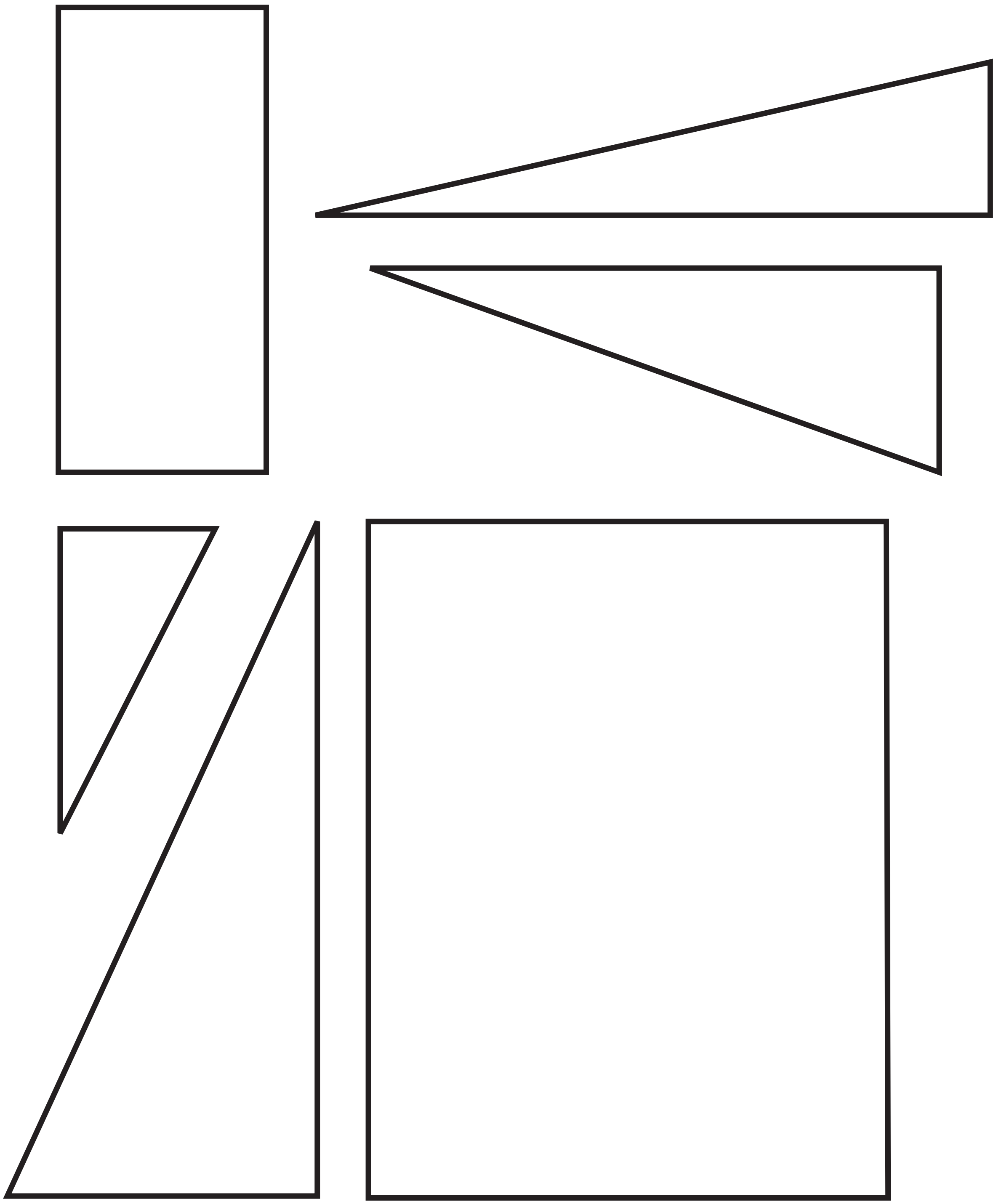
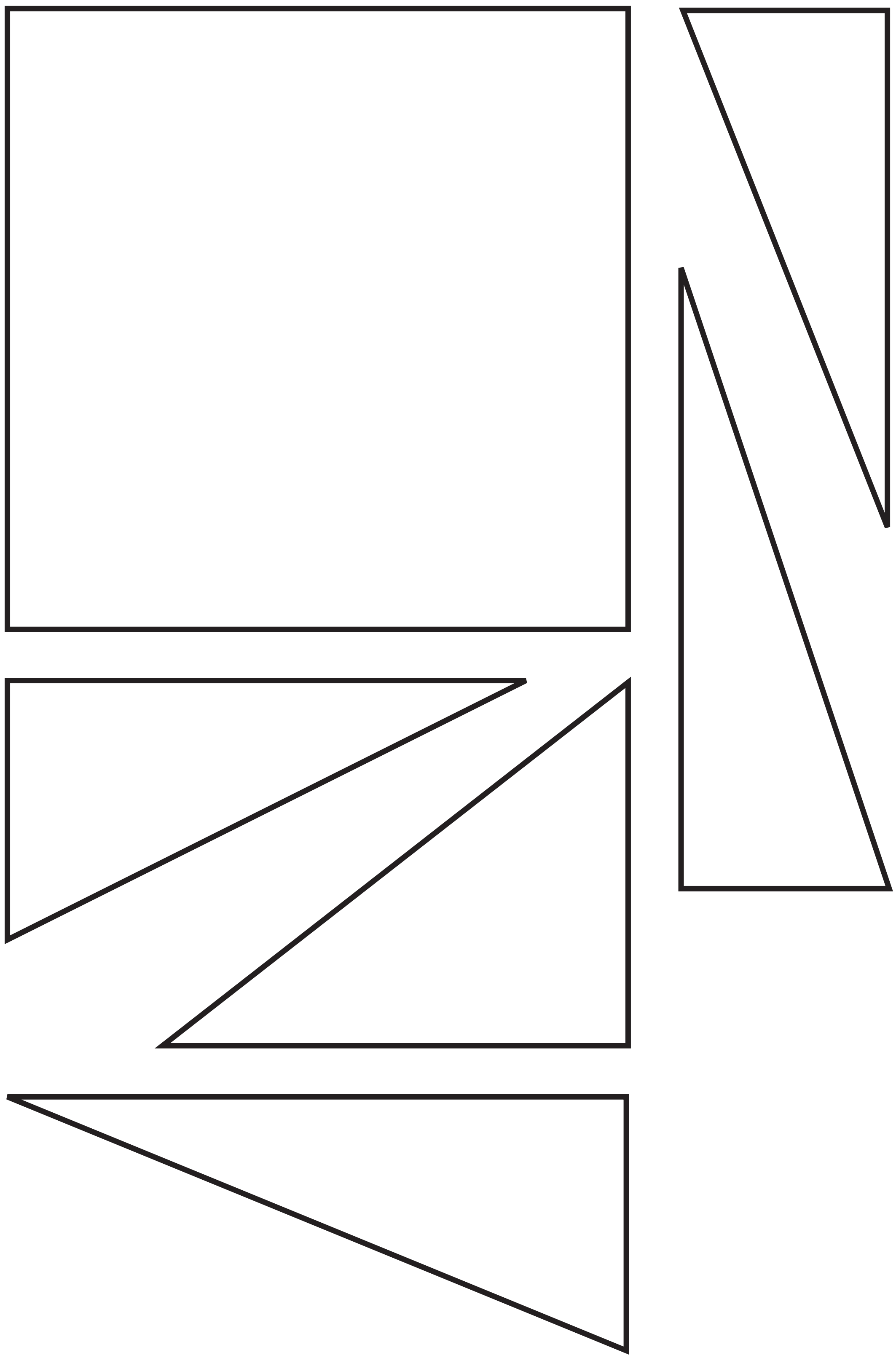


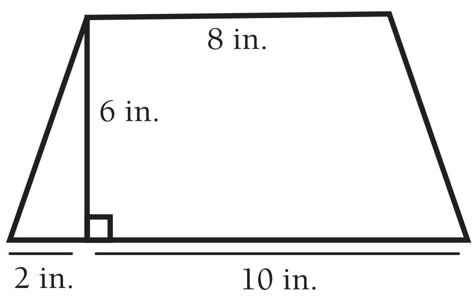
Trapezoid Shapes 3



Trapezoid Assessment

Find the area of each trapezoid.

1.



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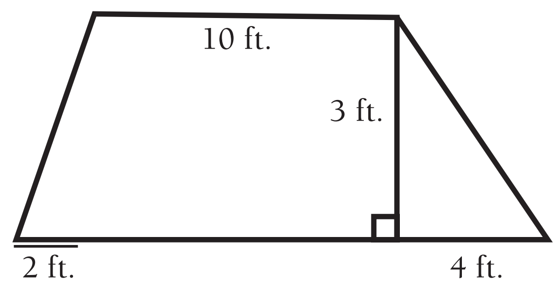

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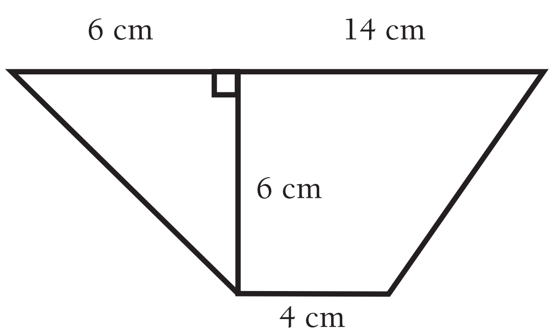

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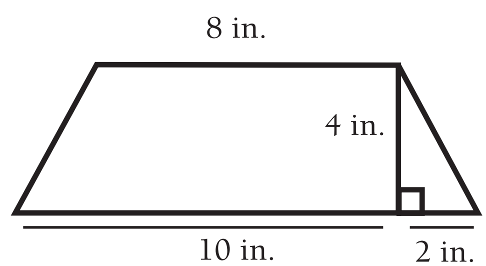
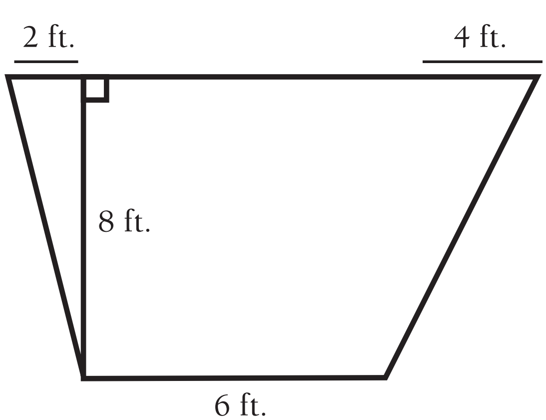
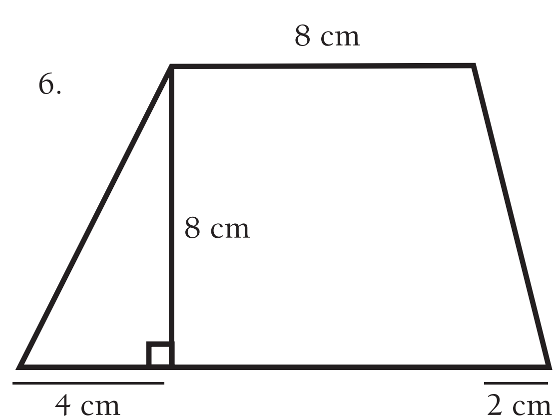


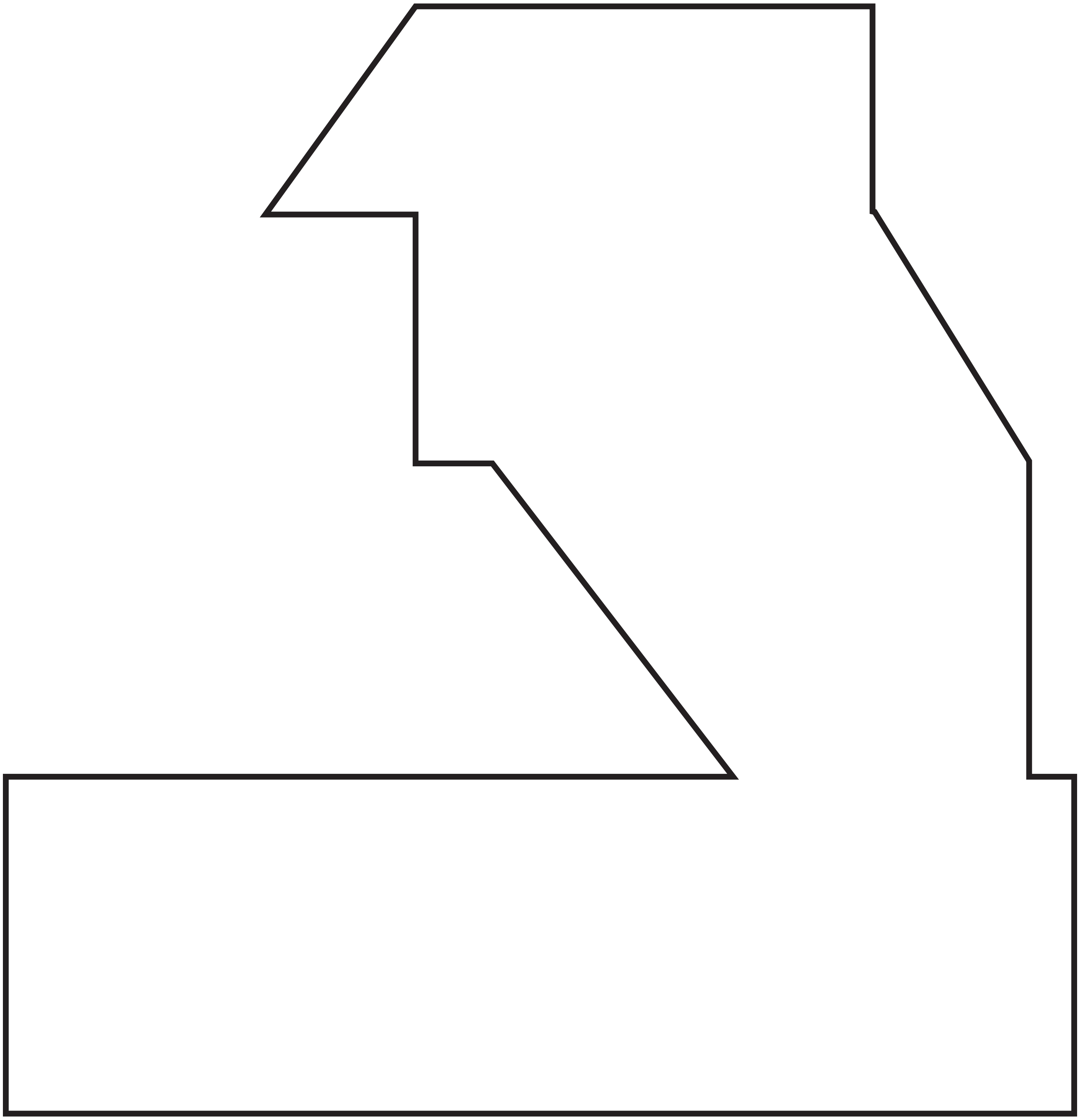
5.



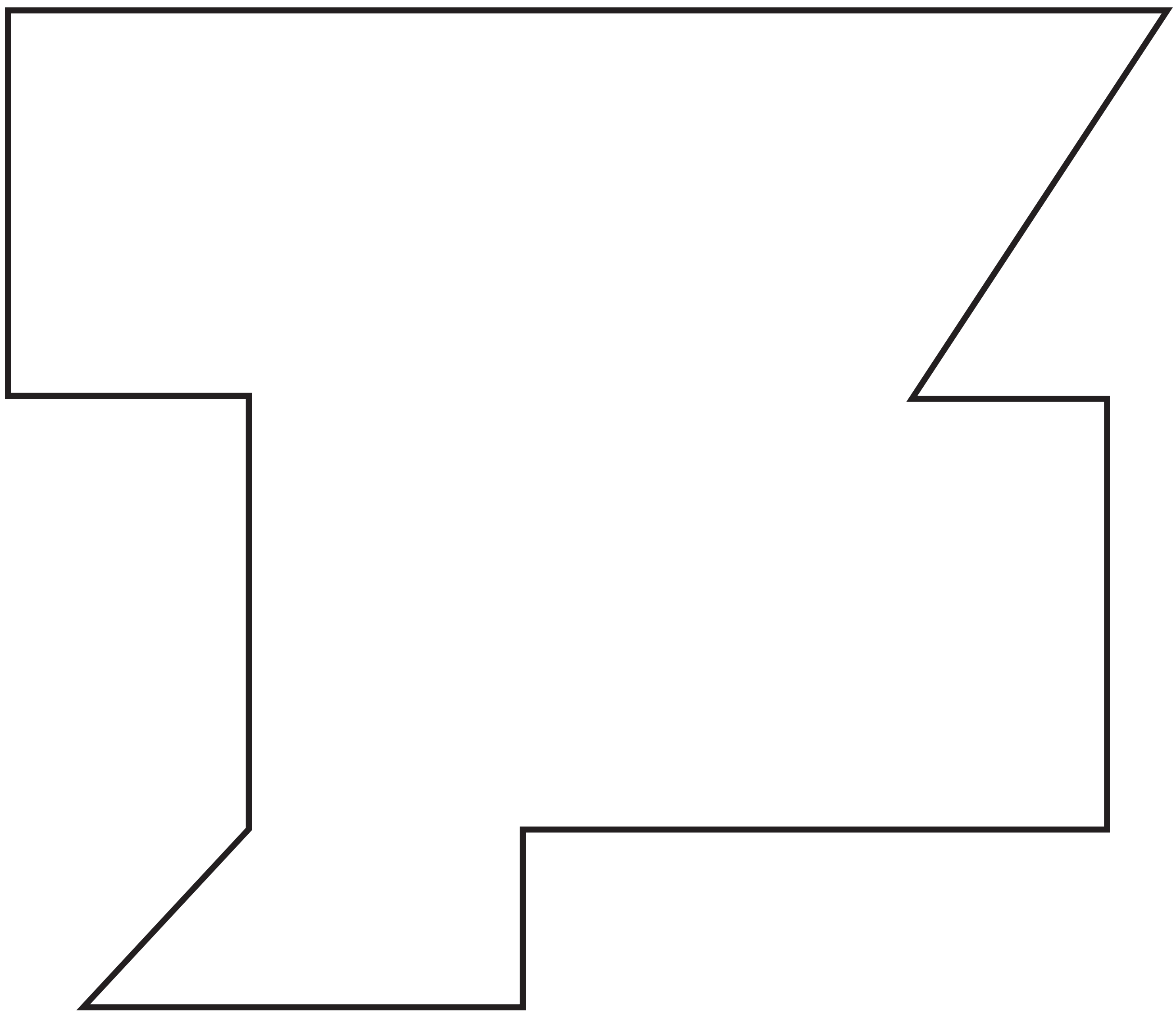
6.



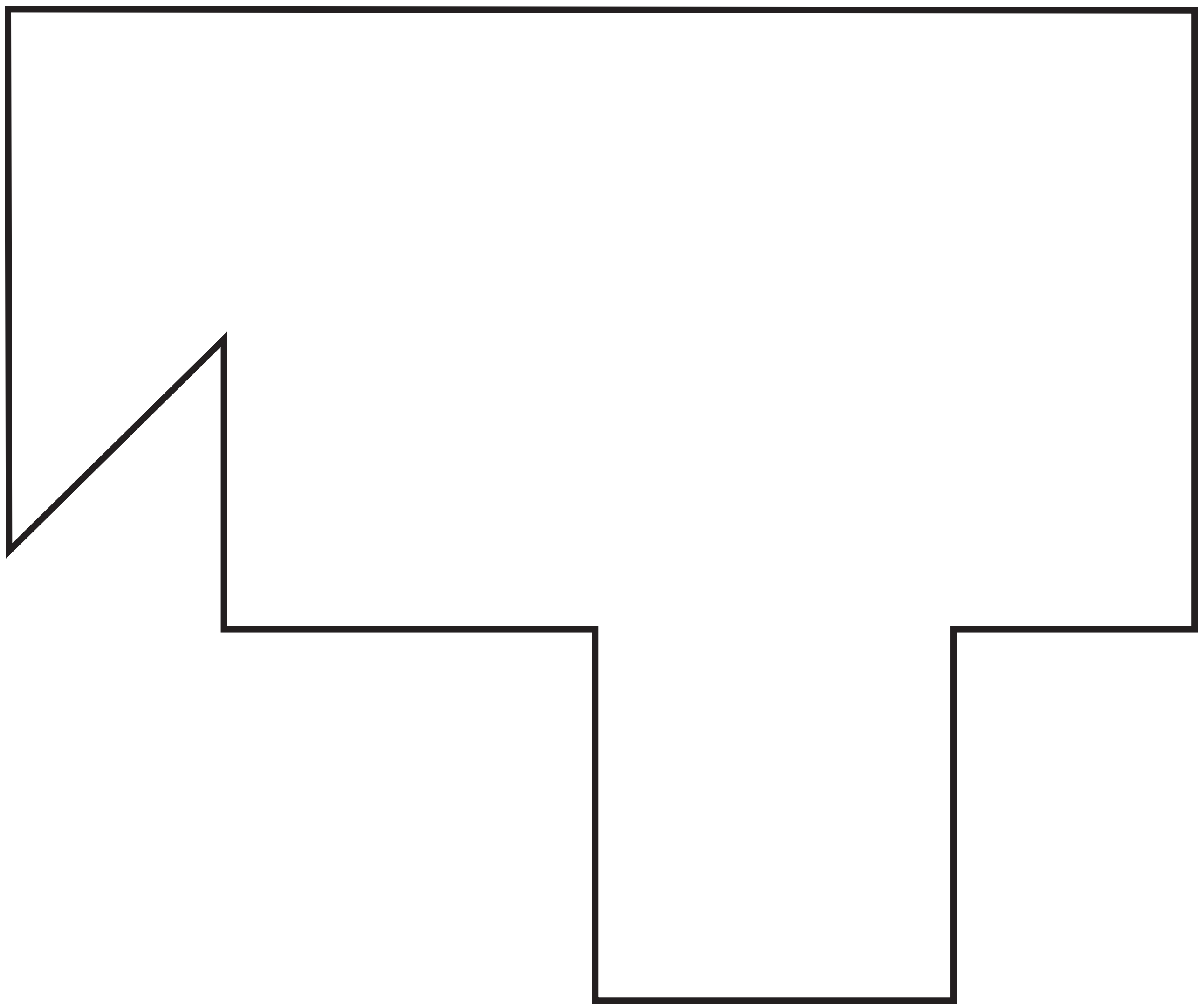
Irregular Polygon Overhead



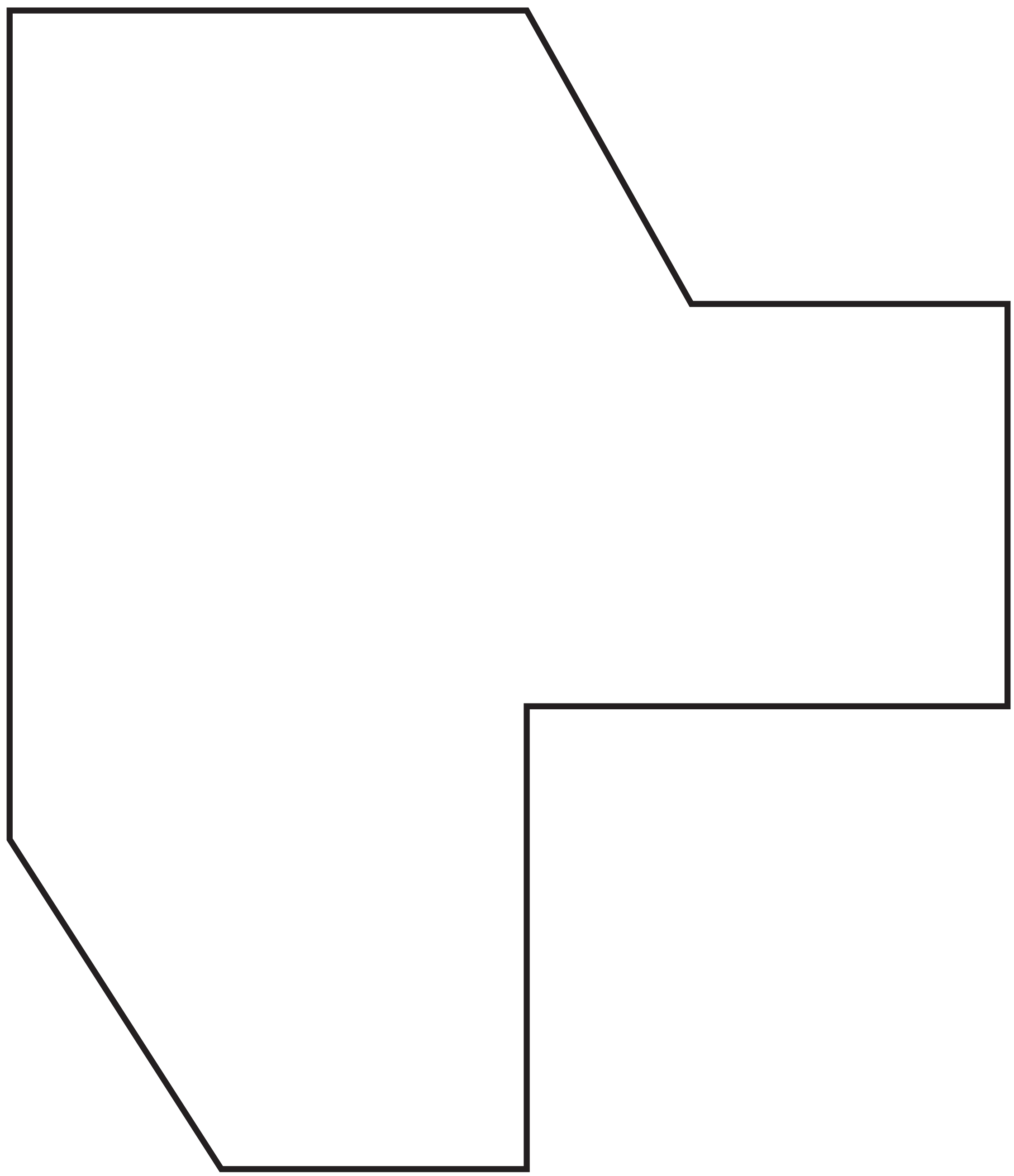
Irregular Polygon 1



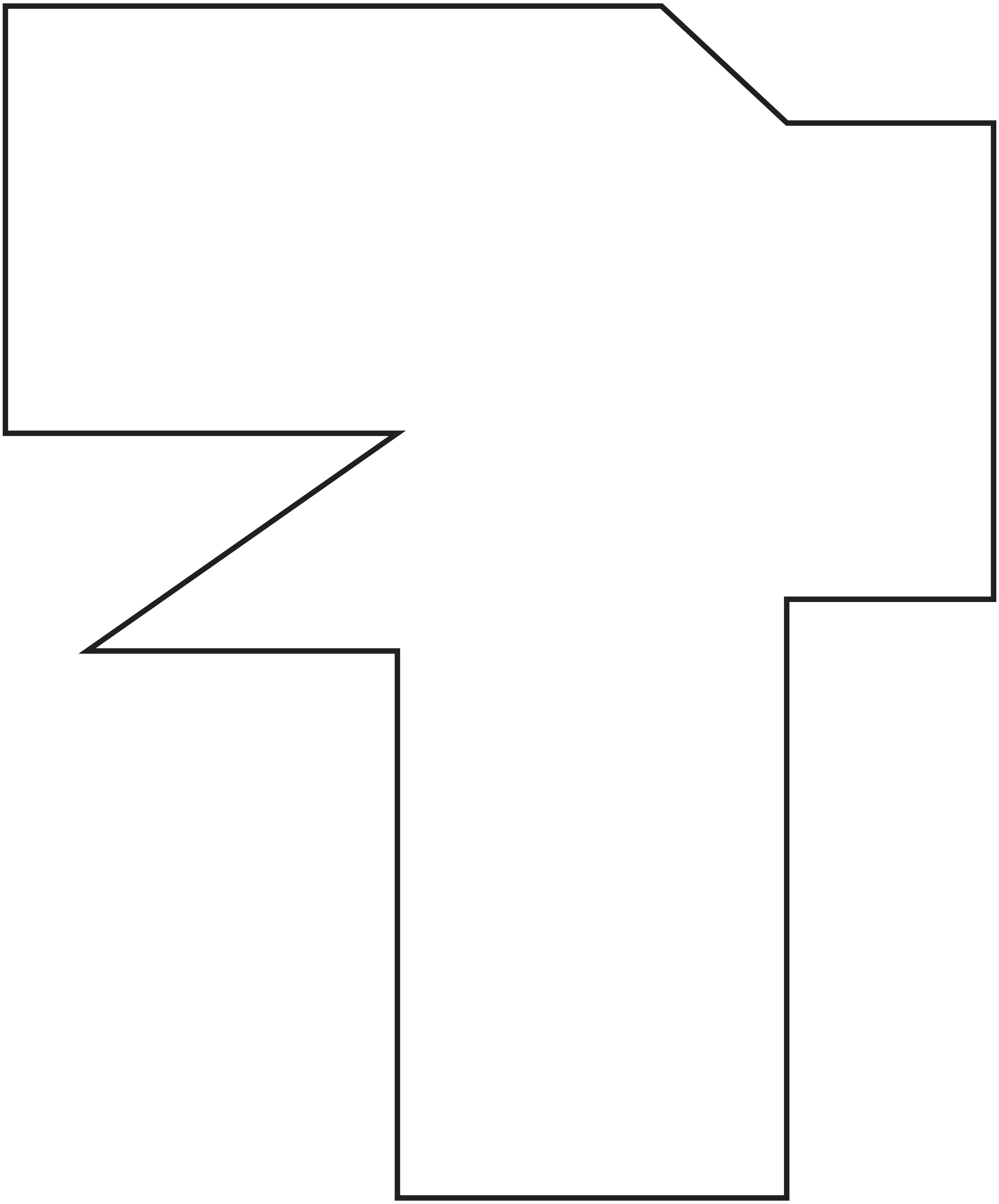
Irregular Polygon 2



Irregular Polygon 3



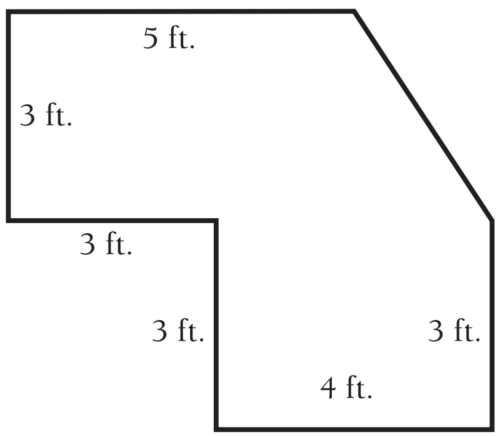
Irregular Polygon 4



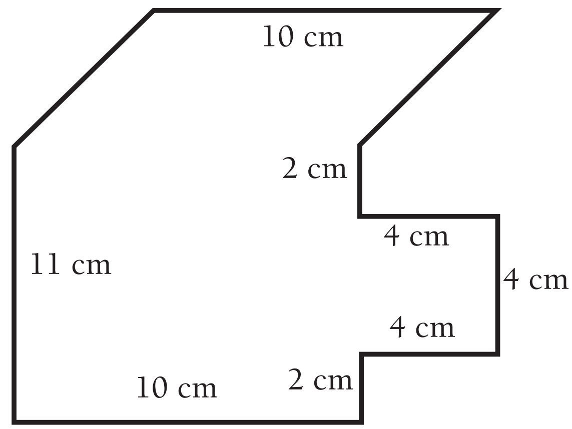
Irregular Polygon Assessment

Find the area:

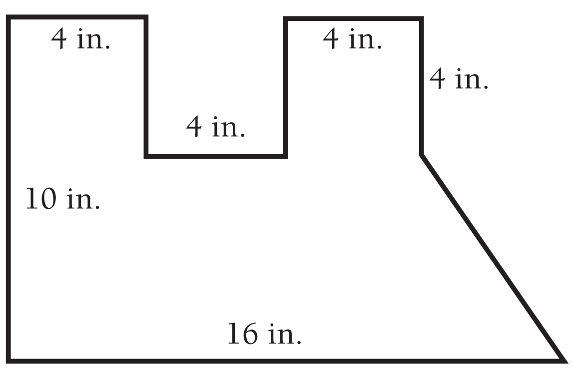
1.



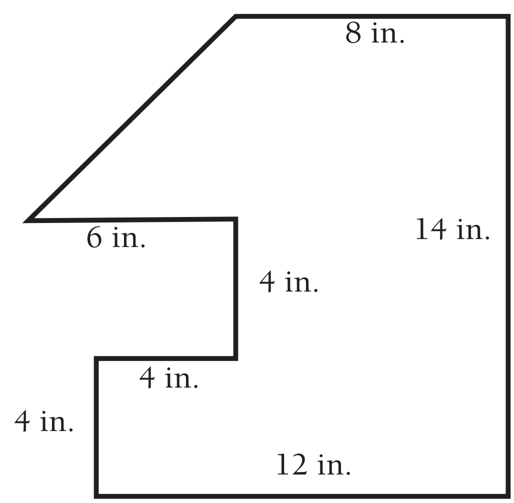
2.



3.



4.



Box It Up

Standard IV:

Students will determine area of polygons and surface area and volume of three-dimensional shapes.

Objective 2:

Recognize, describe, and determine surface area and volume of three-dimensional shapes.

Intended Learning Outcomes:

2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.
4. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics

Content Connections:

Math 2-1; Determine rules for patterns.
Language Arts 1-1; Communicating ideas.

Math Standard IV

Objective 2

Connections

Background Information

In this activity students will be finding the volume of rectangular prisms. The volume of a prism is the amount of space inside the prism. Volume is measured in cubic units, which means it tells how many cubes of a given size it takes to fill the prism. The formula for volume of a right rectangular prism is length x width x height. The formula for volume of a right prism with a triangular base is ½ (length x width) x height.

Research Basis

Von Drasek, L. (2006). Teaching with Children's Books: The "Wow" Factor. *ERIC Source* (ERIC # EJ729683). Retrieved December 10, 2007, from http://eric.ed.gov.

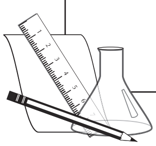
Teaching math through children's books motivates children to learn math in exciting new ways; encourages students to think and reason mathematically and build students' appreciation for math and literature.

Ward, R. (2005). Using Children's Literature to Inspire K-8 Preservice Teachers' Future Mathematics Pedagogy. *ERIC Source* (ERIC # EJ738003). Retrieved December 10, 2007, from http://eric.ed.gov.

A growing body of research in the fields of mathematics education and literacy supports the inclusion of children's literature with teaching and learning mathematics. The author presents a variety of activities and ideas that are sound strategies for effectively integrating children's literature with the teaching of mathematics.

Materials

- *Counting on Frank*
- *Let's Build Boxes*
- Two-cm graph paper
- Multilink cubes
- Scissors
- Tape
- *Which Box?*



Invitation to Learn

Read the book, *Counting on Frank*, to your students. Discuss all of the different things the boy measures in the book. Define volume and look in the book for all of the ways the boy finds volume – 24 Franks in his bedroom, ten humpback whales in the house, 1/10 of his dad in the portable television, peas in the dining room, and 745 jellybeans in the jar. In their journals, have students write a summary about Frank and his "pet" boy. Have them pick a new object and write how many of those objects they think it would take to fill their bedroom. Have some students share their ideas. Explain that we don't usually measure volume in Franks, humpback whales, peas, or jellybeans; instead, we use cubic units to measure volume.

Instructional Procedures

1. Divide students into partners (or groups) and hand out *Let's Build Boxes*.
2. Explain to your class that they are part of a company that builds boxes. Their department is in charge of making the bottom part of the box. They need to make different size boxes and determine how much each box can hold, or the volume of that box.
3. Give each pair of students 4 pieces of two-cm graph paper.
4. Hold up a sheet of graph paper and demonstrate how to trim it to a 9 x 11 rectangle.
5. Have partners trim each of their sheets of graph paper to a 9 x 11 rectangle.
6. Ask students how many unit squares they have on each sheet. Make sure they understand that each sheet has 99 unit squares.
7. Hold up a sheet of trimmed graph paper and cut one unit square from each corner.
8. Fold up the outside rows to make a box. Tape the corners.
9. Tell your students to do the same thing to one of their papers.
10. Have the partners use multilink cubes to fill their boxes.
11. Discuss their findings. What strategies did they use to figure out how many cubes they would need? Did they have to fill the entire box with cubes before they knew how many they would need?

12. Have students fill in the information for Box 1 on their *Let's Build Boxes* assessment. You may need to fill in the data for the first box together as a class.
13. Hold up your second sheet of trimmed paper and cut a 2 x 2 unit square from each corner. Fold up the sides to make a box.
14. Have partners do the same with one of their sheets.
15. Have students make predictions about how many cubes it will take to fill this new box. Will it be more or less than the last box?
16. Have them use multilink cubes to fill the new box and record the results on *Let's Build Boxes.*
17. Discuss their results. How many did it take? Did it take more or less than the last box? Were their predictions correct? If not, why do they think their predictions were off? What strategies did they use to find the number of cubes they needed? Did they have to fill the entire box before they knew how many cubes they would need?
18. Hold up your third 9 x 11 sheet and cut a 3 x 3 unit square from each corner. Make it into a box.
19. Have partners do the same with one of their sheets.
20. Have the class make predictions about how many multilink cubes it will take to fill the next box. Since it took more cubes to fill the second box, will it take more for the third?
21. Have partners use multilink cubes to fill the new box and record results on *Let's Build Boxes.*
22. Discuss their results. Did it take more or less cubes to fill the third box? Why do they think that is the case? Did they use any different strategies this time to find the number of cubes they needed?
23. Hold up the final sheet of graph paper and cut a 4 x 4 unit square from each corner. Make a box.
24. Have partners do the same with their last sheet of graph paper.
25. Make predictions on how many multilink cubes it will take to fill the new box. Will it take more or less than Box 3? Why do they think that?
26. Have partners use multilink cubes to fill the new box and record results on *Let's Build Boxes.*
27. Have students look for patterns in their table and complete the worksheet.

28. Discuss what they noticed about their worksheet. Did they find any patterns? Is there an easier way to find volume than by building boxes and filling them up with multilink cubes? Have the class come up with a formula for finding volume of rectangular solids.
29. In their journals, have students draw a box and label its dimensions. Have them write a paragraph explaining their findings of the activity. Have them record the formula for volume and find the volume of the box they drew.
30. Have students complete the assessment, *Which Box?*

Assessment Suggestions

- Informal assessment includes class discussion and observations.
- *Let's Build Boxes*
- *Which Box?*

Curriculum Extensions/Adaptations/ Integration

- Have advanced learners come up with the formula for volume for a right prism with a triangular base.
- Find the volume of other three-dimensional shapes.
- Do the activity again with two-cm graph paper trimmed to a 9 x 9 square. Have students make as many different boxes as they can, record the information, and look for patterns.

Family Connections

- Have students tell their families the story of Frank and his "pet" boy.
- Give students a few sheets of two-cm graph paper. Have them work with their family to come up with a box bottom that they think will hold the most (has the greatest volume). Bring the boxes back and share their findings with the rest of the class.

Additional Resources

Books

Counting on Frank, by Rod Clement; ISBN 9780395703939

Math on Call, A Mathematics Handbook, by Great Source Education Group; ISBN 0-669-45770-1

Navigating through Measurement in Grades 3-5, by NCTM; ISBN 0-87353-544-8

Let's Build Boxes

	Length (cm)	Width (cm)	Height (number of layers of cubes)	Volume (number of cm cubes needed to fill box)
Box 1				
Box 2				
Box 3				
Box 4				

What patterns do you notice from the chart?

____

____

____

____

Is there an easier way to find volume?

____

____

____

____

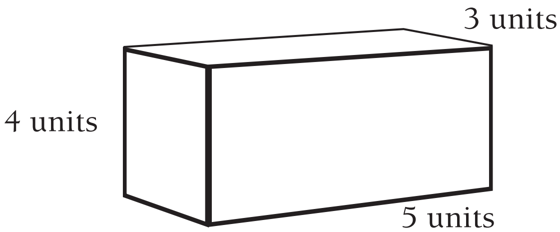
Name ______________________________ Date ______________________________

Two Centimeter Grid

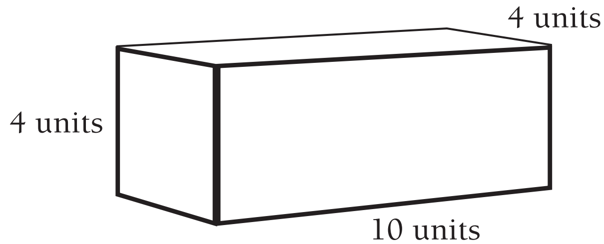
Which Box?

Find the volume of each box and then anwer the questions below.

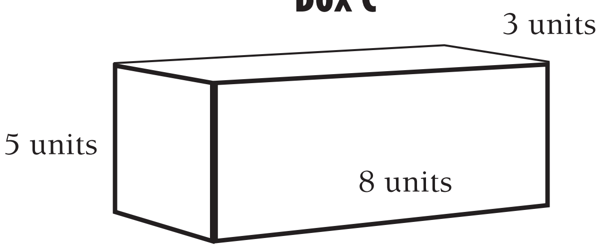
Box A



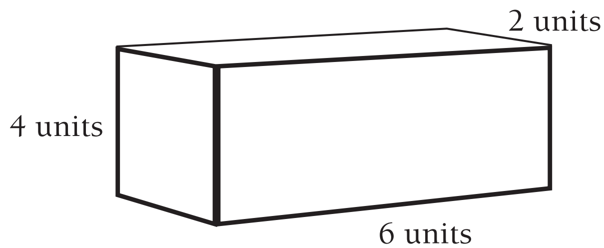
Box B



Box C



Box D



1. Emma needs a box that will hold all 48 of her wood blocks without any extra space. Each of her blocks is one cubic unit. Which box should she choose and why?

2. A toy company has to ship 80 yo yos. They put each yo yo in a small box that is two cubic units. Which box should they choose to ship 80 small boxes that are each two cubic units? Explain your reasoning.

3. That same toy company now needs to ship 60 bouncy balls. They put each ball into a small box that is two cubic units. Which box should they choose to ship 60 small boxes that are each two cubic units? Explain your reasoning.

4. A candy company needs a box to pack 60 of their caramels. Each caramel is one cubic unit. Which box should they choose to pack their caramels if they do not want any extra space? Explain your reasoning.

Candies R Us

Standard IV:
Students will determine area of polygons and surface area and volume of three-dimensional shapes.

Objective 2:
Recognize, describe, and determine surface area and volume of three-dimensional shapes.

Intended Learning Outcomes:

4. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.
5. Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.

Content Connections:
Math III-1; Relate prisms to nets.
Language Arts VIII-6; Produce informational text.

Math Standard IV

Objective 2

Connections

Background Information

In this activity, students will be working with nets to determine the surface area of various boxes. A net is a two-dimensional pattern that can be folded to make a three-dimensional model of a solid, and is an excellent visualization for surface area. Surface area represents the number of squares that cover the surface of a prism. The formula for surface area of a rectangular prism is: $SA = 2(l \times w) + 2(l \times h) + 2(w \times h)$.

Students should already know how to find the area of two-dimensional figures and the volume of three-dimensional figures.

Research Basis

Reid, J. (1992). The effects of Cooperative Learning with Intergroup Competition on the Math Achievement of Seventh Grade Students. *ERIC Source* (ERIC # ED355106). Retrieved November 28, 2007, from http://www.eric.ed.gov.

This paper reports a study designed to determine the effect of cooperative learning strategies on mathematics achievement in seventh graders. Students were divided into two groups. One group participated in cooperative learning strategies, and the other group received individual/competitive instruction. Pre-tests indicated no differences existed in the groups prior to instruction, but that the cooperative learning groups performed significantly higher on the post-test. The paper concluded that cooperative learning strategies are more effective in promoting mathematics achievement.

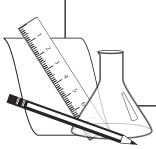
Reineke, J.W. (1993). Making Connections: Talking and Learning in a Fourth-Grade Class. Elementary Subjects Center, Series No. 89. *Eric Source* (ERIC # ED365537). Retrieved December 10, 2007, from http://eric.ed.gov.

This report describes a fourth grade classroom where students' thinking was made public through discussions in which students presented and justified their interpretations of, and solutions to, the problems presented in class. Results suggested that the teacher and her students learned to talk about mathematics in ways that made their thinking visible and indicated that they know mathematics in fresh, inventive ways.

Invitation to Learn

Materials

- ❑ *Net 1*
- ❑ *Net 2*
- ❑ scissors
- ❑ Tape
- ❑ Two-cm graph paper
- ❑ Multilink cubes
- ❑ *Candies R Us Box Designs*
- ❑ *Mixed-Up Pieces*



Give groups of students copies of *Net 1* and *Net 2*. Show them how to make the nets into boxes. Ask your students how the boxes are alike (volume is the same). Ask them how the boxes are different (different shapes). Ask them what the dimensions are for each box. Have them cut the tape and unfold the boxes. Have the students find the surface area for each net. Point out that although the boxes had the same volume, the surface area is not the same.

Instructional Procedures

1. Put students into pairs (or groups).
2. Tell students that the box company where they work just got a new contract from The Candies R Us Candy Company. Their new assignment is to design boxes with lids that will hold 12 of their chocolate candies.
3. Hold up a multilink cube and tell them that the chocolate candies have the same dimensions as the cube.
4. Explain to your class that the volume of the boxes are fixed at twelve, since that is how many chocolate candies the company wants in each box.
5. Tell students that their job is to review all of the possible rectangular boxes with a volume of twelve, and then prepare a presentation to the owners of Candies R Us. Their presentation needs to include a model of the box, and the reasons for choosing that box.
6. Ask students what they think the owners of the candy company would want in a box. Brainstorm ideas. (They might want a box that is easy to ship, convenient to stack and store, and profitable). Ask them: What would make a box profitable? (You might want to remind them about the Invitation to Learn,

but do not tell them about the connection between surface area and the amount of material needed to make the box. Hopefully, if they don't think about it yet, they will discover it as they do the activity.)

7. Give each pair of students twelve multilink cubes and several sheets of two-cm graph paper.
8. Hand out the worksheet *Candies R Us Box Designs*.
9. Have students discover all of the possible boxes that would hold twelve chocolate candies (there are four possible choices).
10. Have them create a net for each of the boxes. Remind them that the paper should not overlap.
11. Have the students fill in the chart on the *Candies R Us Box Designs* worksheet. You may need to demonstrate the data for one box so they understand how to organize the information.
12. Ask students if they notice any patterns in the data on their charts (same volume, V = l x w x h, dimensions are all factors of twelve).
13. Have pairs decide which box they think is best, and discuss the reasons behind that choice.
14. Have the pairs make their presentation to the class. They need to show a model of the box that they would recommend and talk about the reasons that box would be the best option for the candy company.
15. Discuss the results of the activity. What do we call the measure of the number of multilink cubes that a box will hold? (Volume) What was the volume of the boxes you made for Candies R Us? (Twelve) Did the volume change from box to box? (No) What units do we use to measure volume? (Cubic units) Why? (Because volume is a three-dimensional measurement.) Was there a box that more pairs recommended? Why? (This should lead to a discussion on surface area.)
16. Explain to your students that the net they made for each box represents the surface area of the box, or the amount of material needed to cover the box. Ask them if they noticed a general rule for finding the surface area of any box (It is the sum of the areas of each face of the box.) What units do we use to measure surface area? (Square units) Why? (Because area is a two-dimensional measurement.) The volume stayed the same for each box, but what happened to the surface area? When might you want to find the surface area of something?

17. Come up with a formula for finding surface area of a right rectangular prism.

    SA = 2(l x w) + 2(l x h) + 2(w x h).

18. Have students draw a net in their journal and explain what it represents (the surface area of a rectangular prism). Have them write a summary of their findings from the activity. Have them explain how to find the surface area of a right rectangular prism.

19. Have students complete the assessment *Mixed-Up Pieces*.

Assessment Suggestions

- Informal assessment includes observation and class discussions
- *Candies R Us Box Designs*
- Presentation – model of box, reasons behind choice, discuss volume and surface area
- *Mixed-Up Pieces*

Curriculum Extensions/Adaptations/ Integration

- Find the area of other right prisms by using the area of triangles, rectangles and parallelograms.
- Create advertisements for boxes. Use poster board to cover the surface area and decorate the box.
- Create boxes to hold 18 chocolate candies.
- Write a letter to owners of Candies R Us outlining their recommendations and enclosing the net from their box of choice. Have the students discuss the box's surface area and volume and the reasons behind choosing that box. Tell students to make their letter convincing, so the owners will choose their box.

Family Connections

- With a family member, find the surface area of a cereal box or other box from home.
- Wrap a present from home without any overlap. Measure how much wrapping paper was needed to cover the surface area of the box.

Additional Resources

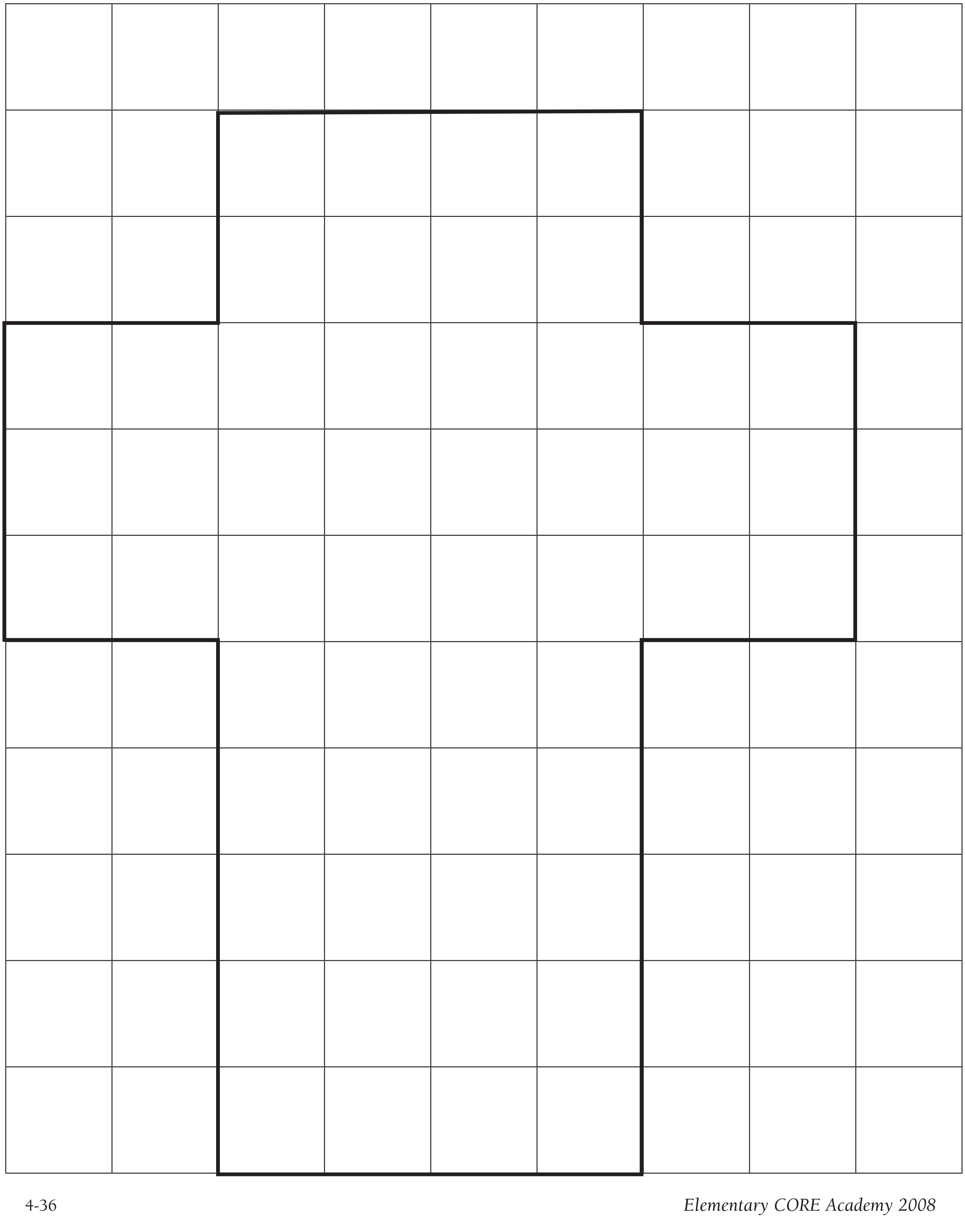
Books

Navigating through Measurement in Grades 3-5, by NCTM; ISBN 0-87353-544-8

Math on Call, A Mathematics Handbook, by Great Source Education Group; ISBN 0-669-45770-1

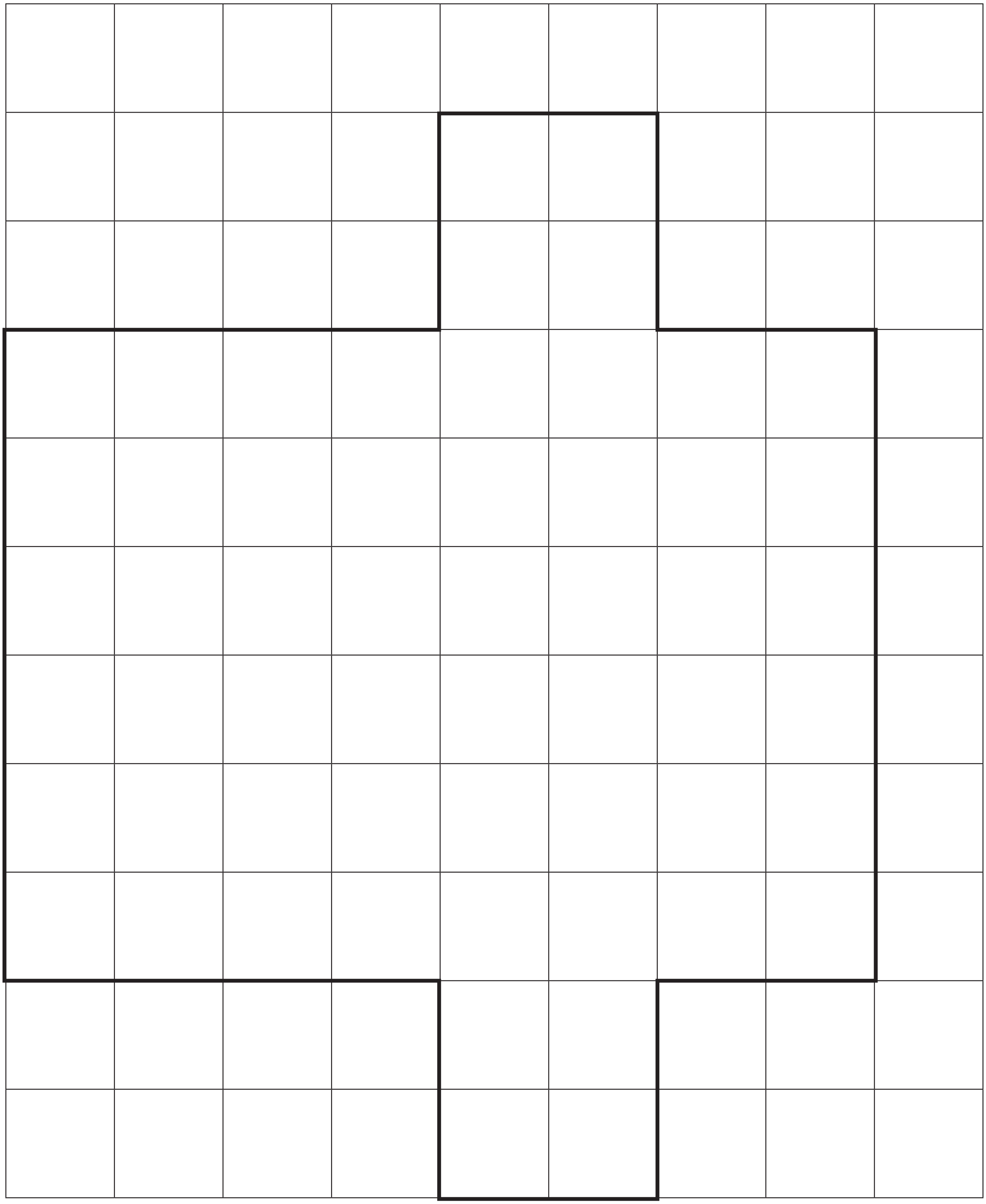
Name ______________________ Date ______________________

Net 1



Name ______________________________ Date ______________________________

Net 2



Candies R Us Box Designs

Using graph paper, make a net for each possible box. Cut it out, fold it, and tape it into a box.

Dimensions of the box	Volume of the box	Sketch of a net of the box	Surface area of the box

Mixed-Up Pieces

You want to play a game with your family but all of the game pieces are mixed up. Use the clues below to figure out which game pieces go with each game.

1. A spinner is needed in the game box that has a surface area of 88 square units. What is the name of the game missing the spinner?

____

2. A blue piece needs to be in the box with the smallest surface area. What game in is missing a blue piece?

____

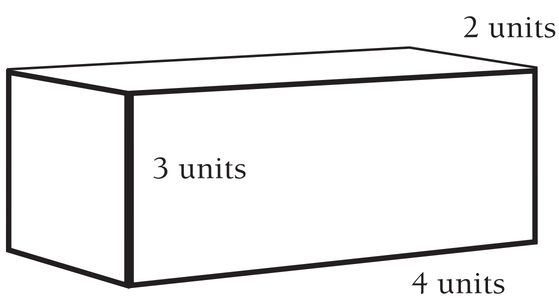
3. A die is supposed to be in the game box that has the largest surface area. Which game is missing the die?

____

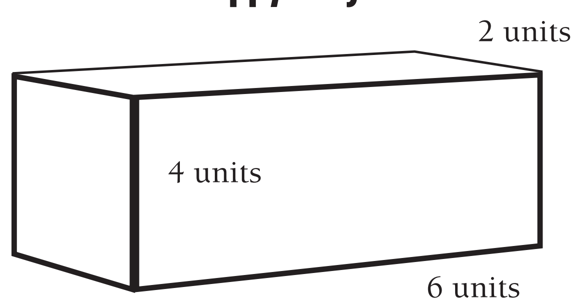
4. Two cards are needed to play the game that has the box with a surface area of 94 square units. What game is missing two cards?

____

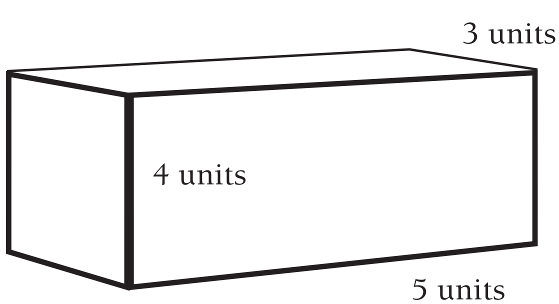
Whodunit?



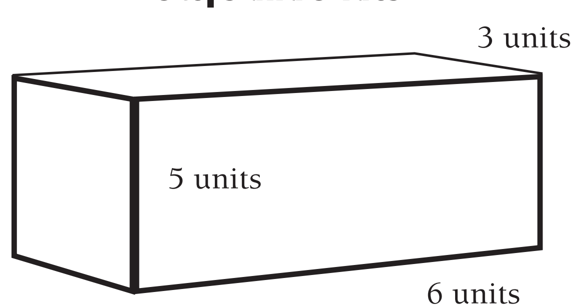
Hoppy Frogs



Jammin' Jane



Steps and Slides



Science I-2&3

Activities

Changing Matter

Hidden Science in Colonial Living

Standard I:
Students will understand that chemical and physical changes occur in matter.

Objective 2:
Evaluate evidence that indicates a physical change has occurred.

Objective 3:
Investigate evidence for changes in matter that occur during a chemical reaction.

Intended Learning Outcomes:
4. Communicate effectively using science language and reasoning.

Content Connections:
Social Studies II-2; United States motivating expansion.
Language Arts VII-3; Apply strategies to comprehend text.

Science Standard I

Objectives 2&3

Connections

Background Information

When settlements were first established in the colonial period and eventually during the western expansion, they all began by growing their own food and making the things they used everyday. Children grew up helping grow the food and making the necessary items for survival and passed these skills onto their own children.

Many of the things that these early settlers made were science related. One could say that they were scientists in their own rights. All of the items they needed were made from matter. Some items went through a physical change and some went through a chemical change. Things such as candles, bricks, soap, butter, bread and woolen items that they made daily, weekly, or monthly fall into the categories of physical or chemical changes.

Research Basis

Black, R. (2005). Why demonstrate matter? *Science and Children*, Vol. 44 (Number 1), page 56.

It is still a good practice to have teacher-centered demonstrations in the classroom. Children get excited when they see unfamiliar objects in front of them that they know are going to part of a science experiment. Careful planning and questions techniques give the teacher more control for the students to understand the results.

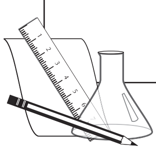
Enfield, M. (2007). Discussion maps make sense. *Science and Children,* Vol. 44, No. 5, pp. 46-49.

Discussion can be useful for teachers in evaluating students' ideas. Discussion offers windows for teachers to help understand student thinking. Through discussions, students can express their ideas. Some students feel more comfortable during a discussion than during any other school task. The "discussion map" lets a teacher gain insight into the students' level of participation and helps the teacher get an idea if the student understands the concept taught.

Invitation to Learn

Materials

- ❑ Bar of soap and/or picture
- ❑ Candle and/or picture
- ❑ Something made of wool and/or picture
- ❑ Bread and/or picture
- ❑ Butter and/or picture
- ❑ Brick and/or picture
- ❑ *The Story of Soap*
- ❑ *The Story of Candles*
- ❑ *The Story of Wool*
- ❑ *The Story of Bread*
- ❑ *The Story of Butter*
- ❑ *The Story of Bricks*
- ❑ Graphic organizers
- ❑ Journals
- ❑ *Physical Change or Chemical Change*



Show the students a bar of soap, candle, loaf of bread (uncut if possible) bar of butter, brick, and something made of wool. (You could use pictures, too, if the items are not available.)

- Ask the students, "If you wanted any of these items, where would they get them?" (From a store.)
- Ask them, "What if there were no stores around, what would you do then?" (They would have to make them themselves.)
- Ask, "Where would you get the materials to make them?" (Some may know the answers that candles come from tallow or wax, bread comes from wheat, butter comes from cream, bricks are made of clay, wool comes from the hair of sheep, and soap is made from lard and lye.)
- Ask, "How would you know how to make them and where to get the materials? (Their parents told them. These learned the survival skills they needed and passed them down from generation to generation.)
- Ask, "How is making these things part of science?" (They needed to figure out how to make these items by experimenting with them. They put ingredients together to make a new substance. They made these items look different from their beginning sources.)

Tell them that for the next couple of days they are going to read about each item to know the history of each and how they were made. They will find out where the materials were found and the process used to make them. They will record some findings in their journals and other findings on graphic organizers. When they are done reading and writing about the items, have the students write how the making of these items relates to science and the changing of matter to a different form by way of physical change and chemical change.

Instructional Procedures

1. Divide the students into six groups.
2. Put each of the listed items at a different station with the product and/or picture with the related reading.

3. Appoint each group to a station. Have the students read about the item and discuss the item.
4. Have the students use a graphic organizer to write down their findings of the history of the item and how it was made. Have them note at the bottom of each sheet how making it relates to changing matter. They can also write things that were interesting to them in their journals.
5. Have them rotate to the next station and do the same thing until they are done with all six stations. (This activity may take two or three days to study each product and write about it.)
6. When the rotations are done, have the students share what they learned.
7. Ask them to also share how each of these items not only has to do with social studies but how science is involved in making each of these items.
8. Have them write in their journals whether each product is made by a physical change or chemical change.

Assessment Suggestions

- Review the graphic organizers to make sure students have written down the important topics and explanations while at each center.
- When the students are done with the centers, have a discussion looking for proper answers and minimizing misconceptions.
- Show the pictures of the items and have the students write the process that is used to make each item (informal assessment).
- Have a discussion about how making these items has to do with changing matter in the form of a physical or chemical change.
- Have the students complete the *Physical Change* or *Chemical Change wor*ksheet.

Curriculum Extensions/Adaptations/ Integration

- All learners can do more research on the daily living in colonial days and what the colonists did each day for survival. They can present what they have learned with displays and reports.
- Advanced learners can learn about inventions from various times in history to make the work easier.

- Learners with special needs can work with others when researching the daily life of the colonists.
- Learners with special needs can look and touch the products in the centers to understand their uses in the home.
- Have the students read the book *If You Lived in Colonial Times* by Ann McGovern. Have them list the things that the colonists made. Have them speculate whether the final product was a physical or chemical change.

Family Connections

- Send pictures and the graphic organizers home of the items that were in the centers and have the students explain to their families what each of them is and how they were made by the colonists.
- Have the students talk to their families about how science is very important in our world and that just about everything that we make or purchase has to do with a scientific process of discovery. Have them come back with a list of items found in their homes that we use each day that are a product of science.

Additional Resources

Books

Colonial Living, by Edwin Tunis; ISBN 9780801862274 (Paperback)

If You Lived in Colonial Times, by Ann McGovern; ISBN 059045160X (Paperback)

If You Lived In Williamsburg in Colonial Days, by Barbara Brenner; 0590929224 (Paperback)

Web sites

http://brebru.com/webquests/colonialtimes/lict/lict.html

http://www.lodi.k12.wi.us/schools/es/lmc/gr5Colonial.htm

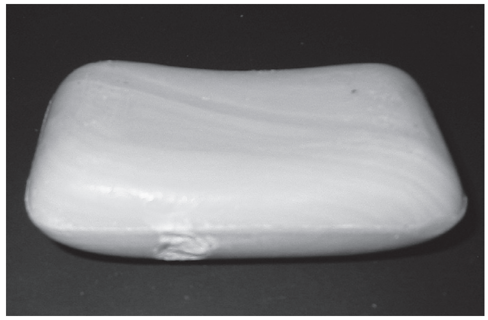
http://ri.essortment.com/coloniallifeco_rndd.htm

http://ag.ansc.purdue.edu/sheep/ansc442/Semprojs/2003/sweater/front.htm

Organizations

Williamsburg, http://en.wikipedia.org/wiki/Colonial_Williamsburg

The Story of Soap

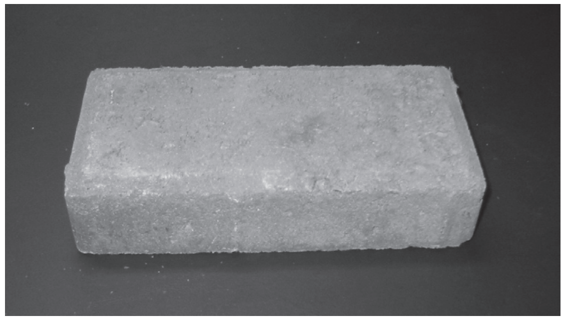


Making soap in colonial days was a hard job. Soap was made from grease and lye. All kinds of fats were saved for soap-making. The ends of tallow candles, deer and bear oil, and other fats went into the grease barrel. Salt was taken out of the grease by washing it in hot water and letting it stand until the clean grease came to the top, leaving the salt in the water at the bottom.

Lye for the soap was also made at home. Ashes from hardwoods such as oak and hickory were saved in a barrel that had clean straw on the bottom. When water was poured in at the top of the barrel and allowed to trickle through the ashes, an alkaline solution called lye was formed. The lye dripped through a small hole at the bottom of the barrel and was collected in a bucket or barrel placed beneath the ash barrel. The lye was tested by putting an egg into it. If the egg floated, the lye was just strong enough to use. This way of making lye was called leaching.

Soap was made in the spring with the grease and ashes saved during the winter. It took about 24 pounds of grease and the lye from six barrels of wood ashes to make a barrel of soft soap. Lye was put in the soap kettle on an open fire out of doors. The grease was slowly added until no more would mix with the lye. The soap was cooked until it was jellylike. The mixture had to be stirred for a long time. The children helped with this. Colonial women were very good at soap-making and could tell just how much grease to use and how long to cook the mixture. When the cooking was finished, the soap was cooled and stored in barrels. Sometimes hard soap was also made. To make hard soap, a brine or salt solution was added to the grease and lye. The soap rose to the top of the kettle. When it had cooled, it could be made into bars. A year's supply of soap was usually made at one time.

The Story of Bricks

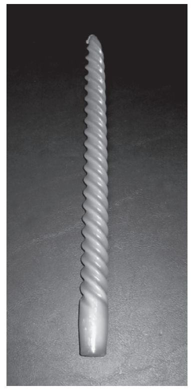


Bricks are the oldest manufactured building material. The first types of bricks were sundried bricks. Sundried bricks, similar to adobe brick, were used in ancient Babylonia, Assyria, and Egypt as early as 4,000 B.C. The chief occupation of the Israelites during their captivity in Egypt was making sun-dried bricks from clay taken from the Nile River. Later, it was discovered that if the dried bricks were put into an oven it gave them greater strength and endured the harshness of the weather. Colonial sundried bricks were first made in Virginia as early as 1612. For the next 300 years, bricks were used to pave streets and sidewalks, and to build chimneys.

Sundried bricks were usually made from clay. After the clay was dug out, it was crushed into a fine granular substance. Enough water was mixed with the clay to make a soft paste to be able to shape the mud. Straw was added to the mud and mixed in to give the brick strength. After the straw was added and the soft paste mud was wet throughout, the mud was ready to be put into a mold. Molds were dipped in water and then sprinkled with sand. The sand acted as a lubricant so the brick-shaped mud could be easily pushed out of the mold. The mud was packed into the mold. It was then pushed out of the mold as the shape of a brick. The mud brick was put in the sun and allowed to be dried in the sun. The hotter the sun, the stronger the brick would be.

Oven-baked bricks were made by the same process. When the bricks were dried throughout, they were stacked in ovens called kilns, which were heated by fire. The temperature in the kiln was increased slowly until it reached 1600 degrees to 2000 degrees or higher, depending on the kind of clay used. The clay particles became partly melted and fused together, making the brick hard and strong.

The Story of Candles



At first some families had only the light from their fireplaces. A few people burned pine knots or candlewood. Pine knots were the part of the pine tree where branches grew out of the trunks. They were full of pitch and burned brightly. They were usually burned in the fireplaces or over a flat stone so that the sticky pitch would not drip on the floor. The inside of the trunk of the pine tree was called candlewood. It was cut into little sticks that were burned for light. Pine knots and candlewood makes a smoky, dripping light because of the pitch in them, but they gave brighter light than other kinds of burning wood. The inside (or pitch) of plants called rushes was sometimes soaked in grease and burned. Such a light was a rushlight.

As soon as they could, people tried to make lamps. An early lamp was made by getting a wick and twisting it around a stick in an open dish or saucer filled with some sort of grease or oil. This was called a saucer lamp. If there was no dish that could be used for a lamp, a vegetable lamp was made by hollowing out a turnip, beet, or potato and putting in a wick. The hole was filled with grease and the wick was lit. Some lamps were made of metal or clay. Some had spouts in which to put the wick and chain hooks so that they could be hung. The hooks could be stuck in the log wall of the cabin. Some of these samples were called Betty lamps.

People found that the best type of candles were those made from tallow or beeswax. They were shaped with a wick down the center. Tallow came from the fat of sheep, cows, or deer. Sometimes beeswax was added to tallow to make the candle harder. One method was to dip a piece of string called the wick into hot tallow. It was dipped again and again. Each time it was dipped, a little more tallow stuck to the wick until the candle was the desired size. These candles were not made one at a time. Wicks were doubled, twisted, and hung on smooth wooden sticks called candle rods. Six or eight wicks were put on each rod. Two straight back chairs were set with the backs facing each other. Two long poles were placed parallel to each other across the backs of the chairs. The candle rods were laid across the poles like the rungs of a ladder. Boards were laid on the floor underneath to catch any wax that dripped down.

Most of the candles were used in the winter. In summer, people got up very early in the morning and went to bed when it was too dark to see without light. Even in winter, candles might not have been used expect for very special occasions. Candles were sometimes placed in lanterns that could be carried from place to place. Some lanterns had glass sides. Other lanterns were made of tin with little holes through which the light was emitted.

The Story of Butter

Butter is the fat of milk in its solid form, principally, from the milk of cows, sheep, and goats. When or where man first learned to concentrate this small portion of milk and utilize it as a semi-storable and high-energy food is unknown. One of the earliest methods of butter making was to fill skin pouches with milk and throw the pouches over the backs of horses. When the horses were made to trot, the milk was agitated and formed butter. Later, as butter became a staple food, various types of churns were devised. These consisted of swinging, rocking rotating barrels, boxes, or cylindrical vessels which had dashers or plungers. The Hindus used butter as a food as early as 2000 B.C. The Scythians and the Greeks used it in the 5th Century B.C. In Europe the making of butter for food was probably introduced very early through Scandinavia. Certainly, it has long been used and relished by man as a spread, in tea, and as a cooking fat.

Butter making was introduced into America in 1607 by the Jamestown colonists, who brought the first dairy cows. The first step in producing butter is to separate the cream from the milk. This was done by placing the milk in pans to let the cream rise to the top. Separated milk is the product from which nearly all the cream has been removed. At this point, the cream that had been collected was allowed to sour by being kept it at room temperature for about a day. This allows the lactic acid bacteria to grow and ripen the cream. The cream was then put in the butter churn and mixed as fast as a person could pull and push on the handle. This continued until the butter formed in the churn where the cream had turned into a solid and a thin liquid.

This thin looking liquid that was left in the churn was buttermilk, the non-fatty part of the cream. It was drained off, and cold water was added to the butter in the churn. The water flushed out any remaining buttermilk. If excess buttermilk was not removed, the butter would spoil. After the water was drained away, salt was added to preserve the butter.

The Story of Bread

Bread is the oldest of all the foods manufactured by man. It also ranks as the most widely eaten, and is often called the staff of life. For thousands of years, people throughout the world have eaten bread in its many different forms. The earliest breads were hard and flat. They were made from a mixture of ground grain and water, and baked in the sun or on hot rocks. Most breads today are leavened, or raised with yeast, baking powder or baking soda.

The bread most widely eaten in the United States is white enriched, sliced and wrapped loaf. But a wide variety of other breads are also made by bakeries in most parts of the country. These include whole wheat, cracked wheat, light and dark ryes, pumpernickel, and Swedish, French and Italian loaves. Corn bread or corn pone is especially popular in the South. Special breads contain nuts, raisins, dates or cinnamon.

Farmers in the United States grow many different kinds of wheats and other grains to make the flours necessary for the various kinds of breads.

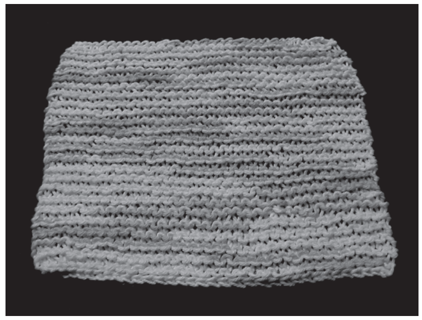
People of other countries prefer different kinds of bread. In the Orient millions of people eat bread made from rice. In Scotland, oatcakes and bannocks made of barley meal are popular. The peoples of Central America enjoy tortillas, or flat cakes of cornmeal dough baked on a non-greased griddle. West Indians make bread flour from the roots of the cassava plant.

Seeds from various wild grasses were long used as foods. Many grains, including oats, corn, barley, rye and rice have been made into breads. Each gives the bread a distinctive taste, color, and texture, but wheat and its ancestors made the most popular breads.

Man found that he could plant seeds that grew and multiplied. He settled in regions where grains grew well, such as the valleys of the Tigris and Euphrates rivers in the Near East.

The Egyptians are usually credited for making the first leavened bread. Leavening changed the character of bread completely. From a hard flat loaf, it became soft, light, and filled with air. Spores from the yeast plants floating in the air may have settled on some of the baker's dough. The yeast fed on the sugars in the mixture and grew. They could not escape from the thick dough, so the multiplying cells expanded the mass into a larger, lighter, more porous substance. The Egyptians also built the first ovens. The lighter bread needed a heated, enclosed area so that the larger mass of dough would bake through. The principles used in making breads are still followed today.

The Story of Wool



The first settlers that came to the United States eastern region brought sheep with them. Even Captain John Smith and his follower brought sheep with them when they settled in Virginia. Soon the number of sheep in the United States eastern region began to grow. From the wool of the thick coats of their sheep, the colonial women wove their blankets and clothing and made the long warm stockings worn by men and women.

As more and more people came to the United States region, more and more woolen cloth was needed. Luckily there were great spaces of land where more sheep could be pastured.

The first step of the colonists in making woolen cloth was shearing the sheep. They were sheared at least once a year with something that looked like large scissors called shears. The whole woolly coat was cut off. If it was cut evenly the fleece would hang together in one piece. Next it needed to be washed since the wool is very greasy and full of sand and dirt. The wool was usually washed in a nearby stream. When it was washed it left the fibers all kinky and tightly matted together. The next step was to straighten out the wool so it would be fluffy and easy to spin. It was straightened out by a pair of hand carders. Hand carders are small tools with wire teeth on one side. The wool was placed between the two carders and drawn back and forth through the teeth until it became a soft, fluffy roll (bunch) of wool ready to be spun into yarn.

There were two ways of spinning yarn. It could either be done by spinning by hand or by a spinning wheel. The colonists spinning by hand tied their “bunch” of carded wool to the thick stick. Then, pulling out tiny tufts of fibers from the wool with the stick, they twisted the wool into thread between their thumbs and fingers. They took the twisted wool off the stick and fastened it to a weight. When the weight was dropped, it dropped slowly towards the ground as the strands of fibers were slowly let out of the “bunch” of wool. As it dropped closer to the ground it also spun. This spinning twisted the strand of wool and drew it out into yarn. When the weight reached the ground, the spinner picked it up, wound up the yarn, and continued the spinning process.

The spinning wheel made yarn much faster. A four-foot wheel was spun by one hand. The four-foot wheel, in turn, spun a smaller wheel with a band made of twine and twisted yarn. Projecting from the small wheel was a spindle which turned very swiftly. With a “bunch” of carded wool in the other hand, fibers of the wool would be connected to the spindle. As the spindle turned, the colonist maneuvered the wool so that a small strand slowly came out of the “bunch”. As the fibers wrapped around the spindle it also twisted the strands into yarn at the same time. Making twists in the yarn made it very strong.

Physical Change or Chemical Change

Everything that is made is either a physical change or a chemical change. Now that you have read about each of the products and written about how they were made by early colonists, make an educated guess whether you think the product is a physical change or chemical change and tell why you think this. (Some of them may involve both a physical change and chemical change in the process.)

1. Making Soap ____________________

____

2. Making Bricks ____________________

____

3. Making Candles ____________________

____

4. Making Butter ____________________

____

5. Making Bread ____________________

____

6. Making Yarn ____________________

____

Changing Matter in Colonial Days

Science Standard I

Objectives 2 & 3

Connections

Standard I:
Students will understand that chemical and physical changes occur in matter.

Objective 2:
Evaluate evidence that indicates a physical change has occurred.

Objective 3:
Investigate evidence for changes in matter that occur during a chemical reaction.

Intended Learning Outcomes:
1. Use science process and thinking skills.
2. Manifest science attitudes and interests.

Content Connections:
Social Studies II-2; United States motivating expansion.
Language Arts VIII-6; Write in different forms

Background Information

In the early colonial times of the 17th Century, everyone was mostly responsible for growing, making, and constructing their own things for survival. This included building cabins and digging wells. They made furniture, doors, latches, toys and tools. They grew their own crops, learned how to cook food, and learned how to store the food and crops to make them last through the winter. They needed bricks for their chimneys, walkways, fireplaces, and roads. Soap and candles were necessary for their cleanliness and for light at night. They also had to learn the great art of making cloth from plants and wool to make clothes. It was truly ingenious how the colonists and their predecessors discovered how to make some of these products. Certain tools were also discovered for the need of making the products.

As we think about the things they made, we can see that they all started from raw matter. This raw matter was changed into a useful product. Some of the "raw matter" went through a physical change and some of the "raw matter" went through a chemical change. The hard part was producing the items by hand with their hand tools. Even today, each finished product starts from raw matter and is changed into a useful product through physical and chemical change. However, today we have other forms of energy and more sophisticated tools.

In the student readings, the students were able to see what "raw matter" was used to make some useful products in colonial days. The students read about the tools that were needed to make these products. They saw that in most cases it was hard, long work.

In the following activities, the students will experience making some of these products. They will rotate through four stations and make the products or observe the products being made. They will experience how colonial people made candles, soap, adobe bricks, and yarn to make cloth in these rotations. Students will personally make some of these products from raw matter, and some will be made by a teacher demonstration for the purpose of safety. Each student will keep a record in a journal of how the product was made and what they discovered. They will also see whether the product was produced by a physical or chemical change.

Research Basis

Myhill, D. (2006). Talk, talk, talk: teaching and learning in whole class discourse. ***Research Papers in Education,*** Vol. 21, No. 1, pp. 19-41

It is important that teachers don't take up too much of student learning time by talking that limits opportunities for pupil learning. Teachers are encouraged to only take up about 15 minutes of whole class time. Teachers are encouraged to use questions for student interaction with each other for discussion and discovery. The teacher only acts as a facilitator during the student learning time. Teachers are also encouraged to have students work in groups to learn from each other.

Bransford, J.D., Brown, A.L., & Cocking, R. R. (Eds). (1999). ***How people learn: brain, mind, experience, and school.*** Washington, DC: National Academy Press

Hands-on learning provides the students with kinesthetic, auditory, and visual learning. As students perform hands-on tasks, they make learning happen for themselves. They learn quickly from their experiences. They begin to make a connection to their world. As this approach is being taught the students learn through the process of inquiry. The teachers should ask many questions during science lessons to make students' thinking process complete.

Invitation to Learn

Explain to the students that when a colonial town was established, some colonists wanted to earn money by having a business instead of farming all day. They had shops making products that colonists needed on a regular basis. From the back of the book *If You Lived in Colonial Times* read out loud some of the stories of what the workers made. Ask questions as to where they got the raw matter to make these products. Ask questions of how the raw matter changed into new products. Students might be able to speculate how the products were made from beginning to the end. Ask questions if the products are a result physical or chemical change.

There is one story about the blacksmith in the book. The blacksmith was the most popular citizen in the town because he knew how to make iron which was strong. The making of iron is a chemical reaction ($Fe_2O3 + 3CO = 3CO_2 + 2Fe$). He could make it into any shape by request with hot coals. Below is some background information that will help them understand how iron was made.

"The basic materials to make iron are iron ore, coke (made by breaking down coal by heating it), and lime (from limestone). The iron ore, coke and lime are put into a furnace. The main purpose of the coke is to use it as a fuel to heat the furnace. As the iron ore melts and the coke burns, the oxygen in the iron ore and the carbon from the coke combine to form carbon dioxide gas. This gas escapes from the furnace leaving a metallic product called pig iron. This pig iron still has impurities which makes weak iron. The purpose of the lime is to aid in the removal of any unwanted impurities in the pig iron such as silicon and phosphorus. The lime produces more carbon monoxide and combines with these unwanted impurities and produces "slag". This slag is in the form of a solid. Even though the slag is a solid, it is lighter than the liquid iron and forms on the surface of the liquid iron. The slag is then lifted off the top of the liquid iron. What is left in the furnace is almost pure iron."

Materials

- ❑ Pictures of process
- ❑ Ash hopper picture
- ❑ Student journal
- ❑ *Notes on Making* ____
- ❑ Store soap
- ❑ Hand-made soap
- ❑ Extension cord
- ❑ Heating unit
- ❑ Measurement Cup
- ❑ Stainless steel pan
- ❑ Steel pot
- ❑ Wooden spoon
- ❑ Soap mold pan
- ❑ Rubber gloves
- ❑ Safety glasses
- ❑ Lye
- ❑ Lard
- ❑ Cold water
- ❑ Digital scale

Instructional Procedures

Activity One Station—Making Soap, Chemical Change

Pre-activity

1. Have students take out their journals for the review.
2. Review what the students learned about how colonists made soap.
3. Discuss how colonists found the materials and tools for making soap.
4. Show a picture of the "soap making" setup and the ash hopper and have a discussion about their uses.
5. Show the container of lye. Discuss why lye was put in the soap. (For disinfecting.)
6. Show the box of lard. Discuss why lard was put in the soap. (For cleaning.)
7. Show a sample of the real lye soap with today's soap. Pass them around and have them discuss what they observe as differences between the two students.

8. Pass out the activity sheet *Notes on Making* __________. (Have students put *Soap* on the line.)
9. Have the students write the tools needed to make soap. Explain why each is needed and have them write the reasons.
   a. Heating unit (for heat)
   b. Measuring cup (for measuring the ingredients)
   c. Stainless steel pan (for making the lye water)
   d. Steel pot (for making the soap)
   e. Wooden spoon (for stirring the ingredients while it cooks)
   f. Soap mold (for shaping the soap)
10. Have the students write down the ingredients needed to make soap. Explain why each is needed and have them write the reasons. Weigh out each ingredient and record the weight.
    a. 1/2 pound lard (for cleaning)
    b. 2/5 cup lye (for disinfectant)
    c. 1 cold cup water (making lye water)
11. Have the students put on their safety glasses.

Making the Soap (This needs to be done outdoors.)

1. As the soap is being made, have the students write the procedure on their activity sheet.
2. Put 1/2-pound of lard in the steel pot.
3. Put the steel pot on a heating unit on high heat to melt the lard. Ask students, "What type of change is this when the lard melts? Explain." (Physical—it is just changing form but is not a new product.)
4. While it is melting make the lye water. Put the water into the stainless steel pan. Let them feel that the water is cold. Pour

the lye into the cold water. Stir it until the lye is dissolved. It will begin to show steam coming from the pan. Ask them, "What type of change is happening in the pan? Explain." (Chemical—it is giving off heat.)

5. When the lard is melted and it's not too hot, slowly pour in the lye water.
6. Stir the mixture constantly over medium-high heat for about twenty minutes until the soap is bubbly and creamy like that of a thin milkshake.
7. During the twenty minutes it is cooking, talk about the importance of soap during colonial times. (It kills germs, cleans off dirt, keeps us from smelling bad, makes people look clean, keeps things sanitary, etc.)
8. Also during this twenty minutes, have the students list at the bottom of the activity sheet what the colonists used the soap for. (Wash hair, hands, body, dishes, clothes, tools, animals, cabin, etc.)
9. When the soap gets to be quite thick and bubbly, pour the soap into the soap mold (bread pan). Get as much out as your can.
10. Ask students, "What type of change is this? Explain." (Chemical—a new product is made.)
11. Explain to them that the lye is no longer lye and the lard is no longer lard. They have mixed as a chemical change where a new product is made for cleaning.
12. Have the students write down their special observations and thoughts about making soap.
13. Have the students write down on the activity sheet what kind of a change it is and explain why.
14. The next day take the soap out as a whole piece. Weigh it. Ask them, "Does it weigh the same as the sum of the three ingredients put in?" Have them write their conclusion. (No, but it is close. Some of the water evaporated and not all of the soap was taken out of the pan.)
15. Cut the soap into eight squares.
16. The squares need to be set aside for about a month. (There is a residue of a weak lye solution on the cubes. It is not harmful, but can sting the skin. Setting the lye aside for the month lets the lye solution evaporate. It does work like soap.)

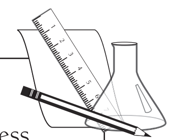
Activity Two Station—Making Sundried Bricks, Physical Change (baked in sun); Chemical Change (baked in oven)

Pre-activity

1. Have students take out their journals for the review.
2. Review what the students learned about how colonists made sundried bricks.
3. Discuss how colonists found the materials and tools for making sundried bricks.
4. Show pictures of colonists making sundried bricks and discuss the pictures.
5. Pass out the activity sheet *Notes on Making* __________. (Have students put *Sundried Bricks* on the line.)
6. Have the students write the tools needed to make bricks. Explain why each is needed and have them write the reasons.
   a. Bowls (mixing in)
   b. Brick mold (shaping the brick)
   c. Measuring cup (for measuring the ingredients)
7. Have the students write down the ingredients needed to make bricks. Explain why each is needed and have them write the reasons. Weigh out each ingredient and record the weight.
   a. 1 cup clay dirt (main ingredient)
   b. 1/3 cup water (for making mud)
   c. Handful of straw (for strengthening the brick)
   d. Sand (to use as a lubricant)
8. Have the students put on their safety glasses.

Making the Sundried Bricks

1. Put the 1 cup of clay dirt in the bowl.
2. Put 1/3 cup of water in the bowl. Mix it together until it has the consistency of bread dough. (If more water or more dirt is needed, weigh it out first then add it.) Ask students, "What type of change happened? Explain." (Physical—it is just changing form but not a new product.)
3. Once the water is mixed with the clay dirt, add a small handful of cut up straw. Ask, "What type of change is happening in the bowl? Explain." (Physical—it is just changing in looks but not a new product.)



Materials

- ❑ Pictures of process
- ❑ Student journal
- ❑ *Notes on Making* _____
- ❑ Store brick
- ❑ Hand-made clay brick
- ❑ Brick mold
- ❑ Measurement cup
- ❑ Deep bowls
- ❑ Sand
- ❑ Clay dirt
- ❑ Straw, cut up
- ❑ Water
- ❑ Digital scale

4. Wet the mold with water and sprinkle sand on it.
5. Put the brick dough into the mold. Press as hard as you can with your hand to compact the brick dough.
6. Shake out the brick while it is still wet. It should come out easy because of the sand.
7. After the students make their bricks, have them write the step-by-step procedure.
8. Have the students write down the colonists' uses of the bricks.
9. Have them write down any special observations and thoughts they had while they were making the bricks.
10. Let them bake in the sun for two days—one day on one side and one day on the other side.
11. After two days, weigh the bricks. Ask them, "Does it weigh the same as the ingredients added together? Explain." (No. The water has evaporated.)
12. Ask them, "What type of change is this? Why? (Physical change--the ingredients are still the same—clay and straw)
13. Have the students write down on the activity sheet what kind of a change it is, and explain why.
14. Ask, "What type of a change is it if the brick was put in an oven? Explain." (Chemical change—the clay melts and combines together with the other clay particles and becomes a new product. It is much more solid and stronger.)

Activity Three Station—Making Candles, Physical Change (making), Chemical Change (burning)

Pre-activity

1. Have students take out their journals for the review.
2. Review what the students learned about how colonists made candles.
3. Discuss how colonists found the materials and tools for making candles.
4. Show pictures of colonists making candles and discuss these pictures.
5. Pass out the activity sheet *Notes on Making* ____________. Fill in the blank with *Candles*.
6. Have the students write the tools needed to make candles. Explain why each is needed and have them write the reasons.
   a. Three tall V8 cans (one to heat the hot wax; one to hold hot wax; one to hold cold water)
   b. Hot plate (used to melt the wax)
   c. Sauce pan (used to hold hot water to heat the hot wax can)
7. Have the students write down the ingredients needed to make candles. Explain why each is needed and have them write the reasons. Weigh out each ingredient and record the weight.
   a. Paraffin wax (main substance of the candle)
   b. Wick (string, for the wax to build on and to light)
   c. Hot water (to create a double broiler to melt the wax)
8. Have the students put on their safety glasses.

Making the Candles

1. Plug in hot plate and set the hot plate on high.
2. Fill a saucepan half filled with water.
3. Fill a V-8 can with broken pieces of cold wax. Place it in the saucepan.
4. Set the saucepan (with the V-8 can filled with cold wax in it) on the hot plate.
5. When the water begins to boil, turn the heat down a bit so it isn't boiling as hard, but still boiling.
6. At this point the wax will begin to melt and continue to melt.

Materials

- ❑ Pictures of process
- ❑ Student journal
- ❑ *Notes on Making* ____
- ❑ Store candle
- ❑ Hand-made candle
- ❑ 3 - V8 cans
- ❑ Hot plate
- ❑ Sauce pan
- ❑ Paraffin wax
- ❑ Wick
- ❑ Hot water
- ❑ Cold water
- ❑ Digital scale

7. Add more hard wax to the can until the wax almost fills the can. (Weight each one.)
8. Give it about 30 to 45 minutes to get a can full of hot wax.
9. At this point put it on simmer until ready to use.
10. Give a wick to each student, the length being a little longer than the length of the V8 can.
11. Fill the second V8 can with cold water and put it on a table with paper on it for easy clean up.
12. When ready to dip candles, take the hot wax can out of the simmering water and place it on a table next to the cold water.
13. Heat up some more wax in the third V8 can. (Weigh out each piece.) (As the hot wax can on the table gets low, put some more hot wax in it from the hot wax can on the hot plate.)
14. Dip the wick into the hot wax can. Pull it out of the wax and dip it into the cold water can. This hardens the wax on the wick.
15. Repeat this procedure many times until you attain the desired size of the candle.
16. If the candle becomes crooked, it can be rolled across a smooth surface.
17. Have the students weigh their candles. Add the weight of each candle. See if the total matches the weight of the wax used.
18. After the students make their candles, have them write the step-by-step procedure.
19. Ask the students, "What type of change is this? Explain" (Physical change. The wax only changed form.)

20. Have the students write down the uses of the candles by the colonists.
21. Have them write down any special observations and thoughts they had while they were making the candles.
22. Have the students write down on the activity sheet what kind of a change it is, and tell why.

Activity Four Station—Making Yarn for Weaving, Physical Change

This will make enough yarn samples for every student.

Pre-activity

1. Have students take out their journals for the review.
2. Review what the students learned about how colonists made yarn.
3. Discuss how colonists found the tools and materials for making yarn.
4. Show the process of how colonists made yarn by showing the pictures in order of the production. Have a discussion about this process.
5. Pass out the activity sheet *Notes on Making* ____________. Fill in the blank with "*Yarn*".
6. Have the students write the tools needed to make yarn. Explain why each is needed and have them write the reasons. Weigh out the ingredients and record the weight.
   a. Sheep shears/big scissors (to cut the wool off the sheep)
   b. Bowl (to wash the yarn)
   c. Soap (to wash the yarn)
   d. Wool carders (to make the wool fluffy)
   e. Spinning wheel/spindle (to spin the fluffy wool into yarn)
   f. Loom (to make clothing)
7. Have the students write down the ingredients needed to make wool. Explain why each is needed and have them write the reasons. Weigh out each ingredient and record it.
   a. Wool from the sheep (main substance)

Making the Yarn

1. Cut a piece of wool from the large piece of wool. Weigh it and record it.

Materials

- ❑ Pictures of a loom, a spindle, sheep sheers, sheering sheep, spinning wheel
- ❑ Student journal with reading notes about yarn
- ❑ *Notes on Making* _____
- ❑ Store bought yarn and home spun yarn
- ❑ Large scissors
- ❑ 2 Wool carders
- ❑ Drop spindle/wire hook
- ❑ Cardboard
- ❑ Skeen of yarn
- ❑ Wool, unprocessed
- ❑ Paper towels
- ❑ Digital scale

2. With the warm water and soap, gently wash the wool so it is clean.
3. Gently dry the wool with a paper towel. Be sure to remove all the moisture.
4. Put the piece of wool on the carders. With the carders on top of each other and opposite each other, pull out and away. Put them on top of each other and pull away again. Repeat many times. Every once in a while, fix the wool on top of the carders. Keep repeating this until the wool is fluffy. Weigh it to see if the weight is the same.
5. Pull out a small tuft of wool. Hook it onto the wire hook.
6. With the help of another person, have the other person spin the wire hook. As the wire hook is being spun, gradually let out small bits of wool. Try not to get it too thick or too thin. Keep doing it until the wool is gone. Wool yarn has just been made.
7. Have the students weigh their wool yarn pieces. Add them up. See if the total matches the weight of the wool used.
8. Ask them, "What kind of change is this? Explain." (Physical change–It is still the same type of material.)
9. After the students make their yarn, have them write the step-by-step procedure.
10. Have the students write down the uses of the yarn by the colonists.

11. Have them write down any special observations and thoughts they had while they were making the yarn.
12. Have the students write down on the activity sheet what kind of a change it is, and tell why.
13. If time allows, follow the instructions below to make a mat out of yarn.

Making the Mat (optional)

1. Take an 8” X 4” piece of cardboard and make half-inch slits about half inches apart on both of the long ends. Fold the cardboard in half so the two slitted ends are across from each other. Keep the slitted ends about three inches apart.
2. Cut off about three yards of regular yarn. Weigh it.
3. With the regular yarn, connect the top slits with the bottom slits by going up and down until all the slits have yarn through them keeping the opening about three inches apart. Cut the yarn off and tie both ends to the ends of the cardboard.
4. Take the rest of the yarn and tie it to the eraser end of a sharpened pencil. Tie the other end to the one of the end strings on the loom.
5. With a pencil, weave the pencil in and out of the yarn strings on the loom. Then, pull the yarn through. The first weave has just been made. Take the pencil back the other way, weaving it through the yarn strings on the loom. It is back where it started.
6. Keep doing this over and over until the loom is filled with woven yarn.
7. Ask them, “What kind of change is this? Why? (Physical change–It is still the same type of material.)
8. Have the students write the step-by-step procedure.
9. Have the students write down any special observations and thoughts they had while they were making the yarn mat.
10. Have the students write down on the activity sheet what kind of a change it is, and explain why.

Assessment Suggestions

- Review the activity sheets that students did. Check for accuracy and completeness.
- Take pictures of the students at each of the activities. As the pictures are shown, have the students relate what is happening

at each station. Have them relate whether it was a physical change or a chemical change.

- Make an assessment with each of the products of the four stations with pictures. Have the students tell if each product is a result of a physical change or a chemical change. Have them explain why.

Curriculum Extensions/Adaptations/ Integration

- The advanced learners can learn more about how iron was made. Have them read more about the blacksmith and how he was able to make iron. They can also read how he was able to bend iron to make different products.
- The advanced learners can learn more about the tools used in the activities and about to how they were made.
- The advanced learners can learn more about the physical and chemical reactions of each of the activities.
- The advanced learners can learn about other products that were made by colonists—how they were made and if the product is a result of physical or chemical change.
- For learners with special needs, there are many easy reader books in the library that tell about colonial living. After they read them, have them write if the product is a physical or chemical change.

Family Connections

- Have the students take home their product from each station. Have them tell about each one by describing how it was made. Have them tell if each was the product of a physical or chemical change.
- As a family visit Pioneer Heritage Park and see how these products and others were made. Watch carefully if they were made by physical or chemical changes.

Additional Resources

Books

Colonial Living, by Edwin Tunis; ISBN 9780801862274 (Paperback)

If You Lived in Colonial Times, by Ann McGovern; ISBN 059045160X (Paperback)

If You Lived In Williamsburg in Colonial Days, by Barbara Brenner; 0590929224 (Paperback)

Web sites

http://brebru.com/webquests/colonialtimes/lict/lict.html

http://www.lodi.k12.wi.us/schools/es/lmc/gr5Colonial.htm

http://ri.essortment.com/coloniallifeco_rndd.htm

http://ag.ansc.purdue.edu/sheep/ansc442/Semprojs/2003/sweater/front.htm

Organizations

Williamsburg, http://en.wikipedia.org/wiki/Colonial_Williamsburg

Notes on Making ____________

I. Write down the tools needed, along with their uses:

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

II. List of ingredients, their purposes, and their weights

a.____

b.____

c. ____

d.____

III. Write the steps needed to make the product. Write down any physical or chemical changes observed.

____

____

____

____

____

____

____

IV. Uses of the product:

V. Thoughts and discoveries while making the product

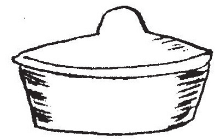
VI. Chemical or Physical Change? Explain

Colonial Tools

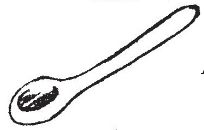
Bread:

Mixing Pan

Dutch Oven



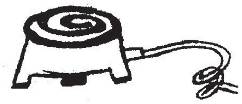
Wooden Spoon



Asbestos Hot Pad

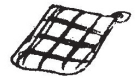
Measuring Cup

Hot Plate

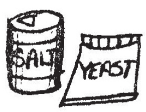


Bread Pan

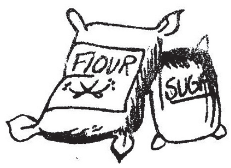
Dish Towel, Hot Pad



Ingredients



Bread Board



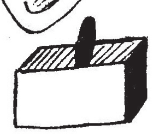
Knife

Butter:

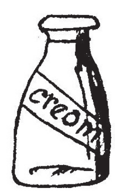
Butter Churn
Butter Plate
Package Salt

Butter Spoon

Butter Mold



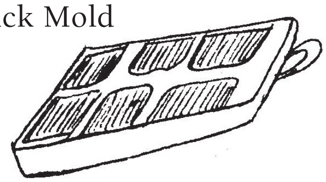
Bottle of Cream
one pint



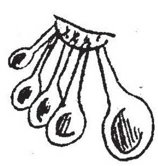
Bricks:

Mixing Pan
Wooden Spoon

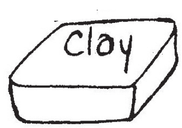
Brick Mold

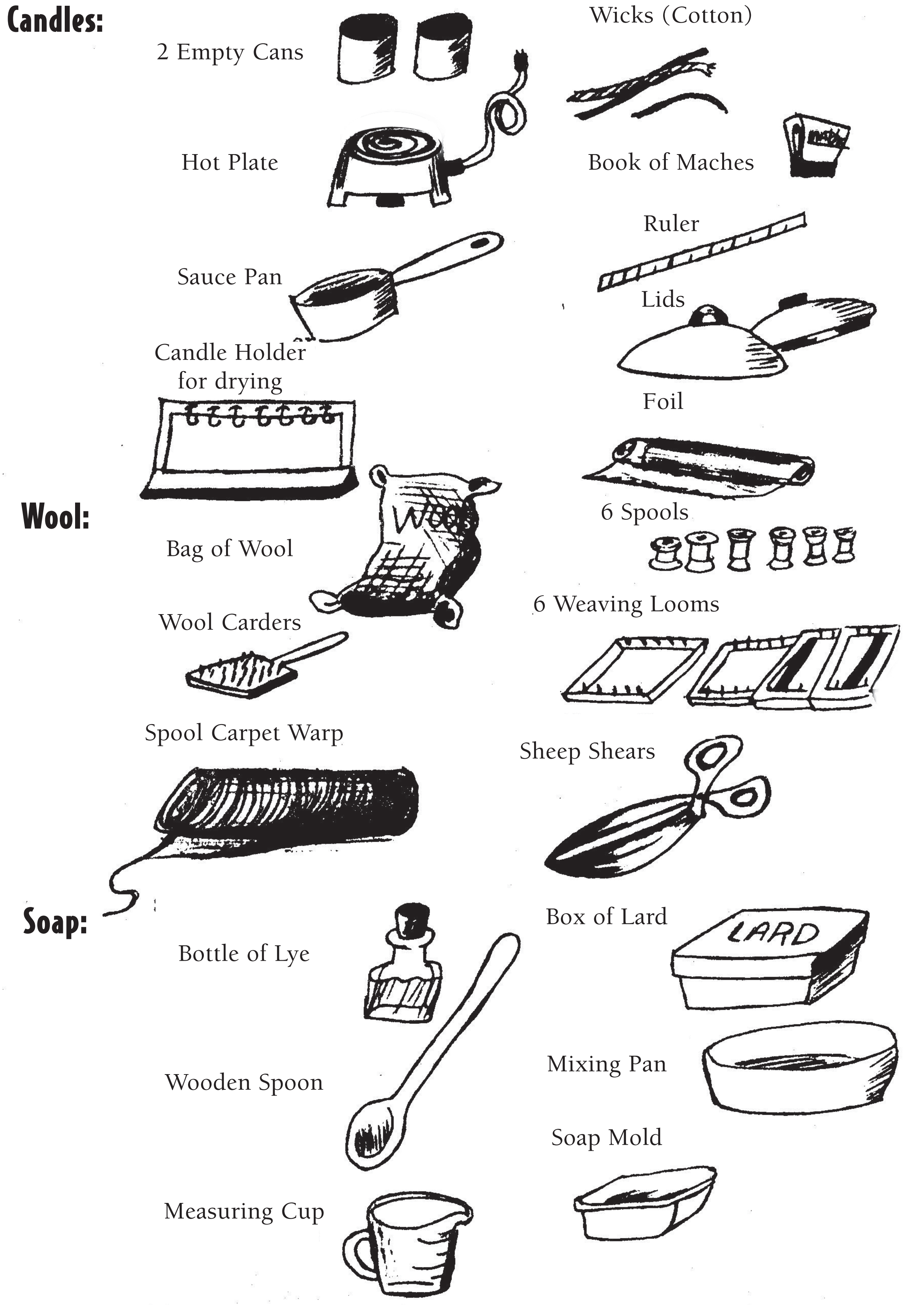


Measuring Spoon
Measuring Cup



Clay, Straw




Candles:
2 Empty Cans
Hot Plate
Sauce Pan
Candle Holder
for drying
Wicks (Cotton)
Book of Maches
Ruler
Lids
Foil
6 Spools
Wool:
Bag of Wool
Wool Carders
Spool Carpet Warp
6 Weaving Looms
Sheep Shears
Soap:
Bottle of Lye
Wooden Spoon
Measuring Cup
Box of Lard
LARD
Mixing Pan
Soap Mold

Food Matters

Science Standard IV

Objectives 2 & 3

Connections

Standard IV:
Students will understand that chemical and physical changes occur in matter.

Objective 2:
Evaluate evidence that indicates a physical change has occurred.

Objective 3:
Investigate evidence for changes in matter that occur during a chemical reaction.

Intended Learning Outcomes:
1. Use Science Process and Thinking Skills
2. Manifest Science Attitudes and Interests

Content Connections:
Social Studies II-2 United States motivating expansion.
Language Arts VIII-6 Write in different forms

Background Information

Cooking was one of the most important parts of colonial living. The colonists learned many ways to cook the same type of food so it didn't look the same each night. One of the highlights of the meal was bread. Bread was only made once or twice a week in an oven made in the wall of the fireplace. Maple sticks were put in the oven to burn to get the walls of the oven very hot. Once the walls were hot the ashes were scraped out and the dough was put in the oven. The bread would bake over night and the bread would be taken out in the morning.

There are two types of chemical changes here. One is the burning of the firewood. The other, is the dough changing into bread.

Another commodity that was made and used extensively by colonists was butter. Butter was not only used on bread, but used for all types of cooking and put on food to eat. It made food taste good.

Changing cream into butter is a physical change.

In the following activities, the students will experience seeing bread made and experience making butter. They will rotate to the two stations and make the products or observe the products being made. They will experience how colonial people made bread and butter. Students will personally make some of these products from raw matter, and some will be made by a teacher demonstration for the purpose of safety. Each student will keep a record in a journal about how each product was made and what they discovered. They will also see whether the product was produced by a physical or chemical change.

Research Basis

Armstrong, T. (1994). ***Multiple intelligences in the classroom.*** Alexandria, VA: Association for Supervision and Curriculum Development.

Multiple intelligences let students choose a method of learning in connecting one subject to other subjects to their world. The integration of instructional methods focuses on teaching a standard in one curricular area and matching it to a standard in another curricular area such as integrating science with language arts, math, math, or social studies. As educators teach with this idea in mind it helps students see a connection between subjects relating to the real world. It helps students understand their world better to see how subjects relate to each other. This method puts into practice the teaching of multiple intelligences.

Ketch, A. (2005). Conversation: the comprehension connection. ***The Reading Teacher,*** Vol. 59, No. 1, pp. 8-18.

Students who engage in conversation in the classroom become reflective thinkers. Conversation brings meaning to students as they contemplate to understand our complex world. Conversation is the comprehension connection. There are literature circles, book clubs, whole-class discussions, pair-share, small-group discussion, and individual conferences that help in conversation comprehension.

Invitation to Learn

Hand out a store-made sugar cookie to each class member. Ask the students where the cookie came from. (They will probably say that it came from a store.) Ask the students where the store got it. (They will say from a cookie factory for they have probably visited one before.) Then ask them, how did they make the cookie? (They had different ingredients that they put into the cookie.)

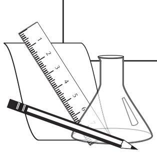
Draw a big pot on the board. Have the students name all the ingredients that went into the cookie (sugar, milk, eggs, vanilla, flour, baking power, etc.). Write the words in the pot on the board. Ask the students, as the ingredients are being mixed, what does it turn into? (Cookie dough) Then ask them that even though we can't see any of the ingredients, are they all still in the cookie dough? (Yes) In fact, it is possible that a chemist could analyze the cookie dough and actually tell us what was in the dough because it is still in there. What kind of change is this called when we just mix things together but the substances still exist? (A physical change.)

But, we don't want to eat cookie dough. We want a cookie. What do we do to make a cookie out of cookie dough? (It is baked in the oven with heat.) When we take the cookies out of the oven, are they still a mixture of sugar, milk, eggs, vanilla, flour, and baking powder? (No) Why not? (They have gone through a chemical change.) What does a chemical change mean? A chemical change is a process where one type of substance is chemically changed into a totally different substance. Usually, if heat is used it is a chemical change. Heat melts substances and combines them with other substances. Sometimes things fizzle, give off heat, and change into a new substance that feels different. Chemical changes occur every day all around us, especially when we are cooking.

Today we are going to look at two foods that are made everyday to see what type of change they go through. We will split you into two groups.

Materials

- ❑ Pictures of process
- ❑ Student journal
- ❑ *Notes on Making* _____
- ❑ Store bread
- ❑ Hand-made bread
- ❑ Wooden spoon
- ❑ Mixing pan
- ❑ Measuring spoons
- ❑ Measuring cup
- ❑ Bread pan
- ❑ Hot pad
- ❑ Oven
- ❑ Dish towel
- ❑ Sugar
- ❑ Salt
- ❑ Yeast
- ❑ Flour
- ❑ Butter
- ❑ Water



Instructional Procedures

Activity One Group—Making Bread—Physical Change (dough); Chemical Change (bread)

Pre-activity

1. Have students take out their journals for the review.
2. Review what the students learned about how colonists made bread.
3. Discuss how colonists found the materials for making bread.
4. Show pictures of the colonists making bread and the oven they used. Have a discussion about them.
5. Pass out the activity sheet *Notes on Making* ______________. (Have students write *Bread* on the line.)
6. Have the students write the tools needed to make bread. Explain why each is needed and have them write the reasons.
   a. Wooden spoon (for stirring)
   b. Mixing pan (for mixing the ingredients)
   c. Measuring spoons (to measure out small measurements)
   d. Measuring cup (to measure out large measurements)
   e. Bread pan (for baking the bread dough in)
   f. Hot pad (to handle the hot pan easily)
   g. Oven (to bake the bread in)
   h. Dish towel (to put over the dough while rising)
7. Have the students write down the ingredients needed to make bread. Explain why each is needed and have them write the

reasons. Weigh out each ingredient and record the weight. Have the students put on their safety glasses.

a. Sugar (to sweeten the bread)
b. Salt (to give the bread flavor)
c. Yeast (to make the bread rise)
d. Flour (main substance of the bread)
e. Butter (to give the bread flavor, helps it bake better)
f. Water (helps mix the ingredients together)

Making the Bread Dough

1. Since the students are watching, have them write down the procedure as they are listening.
2. In a small bowl, put 1cup of luke-warm water and 2 teaspoons of yeast. Let it sit for a moment to fizz up.
3. Measure and stir into the mixing pan the items below and stir them in.
    a. The bowl of water and yeast
    b. 2 teaspoons butter
    c. 2 tablespoons sugar
4. Put 3 cups of flour and 1 teaspoon of salt into the pan and mix with wooden spoon.
5. Stir until you can knead the dough with your hands. Knead at least 100 times. Gather all loose flour in the pan into the dough in the kneading process. (Colonial mothers found that the more times they kneaded the dough, the better tasting and better looking their loaves would be. Kneading makes it light weight and gives it a fine texture.)
6. Cover the pan with a dish towel and let it rise for 30 minutes.

7. Knead the dough again until all the air is kneaded out.
8. Put dusting of flour on your hands so dough won't stick.
9. Form into a loaf. Shape carefully.
10. Butter the bread pan and put the dough in it. Let it rise for 15 minutes.
11. Ask them, "What type of change is this? Why? (Physical change--the ingredients are just mixed together.)
12. Weigh the dough. Compare it with the weight of the ingredients.
13. Have the students write down on the activity sheet what kind of a change it is, and tell why.

Baking the Bread Dough

15. Preheat the oven at 350 degrees.
16. Put the pan into the oven when the oven has preheated. Bake for 20 to 30 minutes or until the bread is well browned.
17. Take out the bread and turn the pan upside down to get the bread out.
18. What type of change did the bread go through? Why? (Physical change because it was heated and a new product was made.)
19. Weigh the bread and compare it to the weight of the dough. Why did it change? (It lost moisture.)
20. Have the students write down the uses of the bread dough by the colonists.
21. Have them write down any special observations and thoughts while they were making the candles.
22. Have the students write down on the activity sheet what kind of a change it is, and tell why.
23. For safety reasons, have store bought bread for the students to eat.
24. Can have jam and butter available if desired.

Activity Two Group—Making Butter—Physical Change

Pre-activity

1. Have students take out their journals for the review.
2. Review what the students learned of how colonists made butter.
3. Discuss how colonists found the materials for making butter.

4. Show a picture of the butter churn, cream bucket, butter bowl, butter mold. Have a discussion about them.
5. Pass out the activity sheet *Making* ______________. (Have them put *Butter* on the line.)
6. Have the students write the tools needed to make butter. Explain why each is needed and have them write the reasons.
   a. Pint jar with lid (used to shake the cream)
   b. Wooden spoon (to take the butter out of the jar)
   c. Butter plate (to put the butter on)
1. Have the students write down the ingredients needed to make soap. Explain why each is needed and have them write the reasons. Weigh out each ingredient and record the weight.
   a. ½ pint (liquid) whipping cream (main substance to making butter)
   b. Salt (to preserve the butter and give it flavor)
   c. Cold water (to separate the buttermilk from the butter)

Materials

- ❑ Pictures process
- ❑ Student journal
- ❑ *Notes on Making* ______________
- ❑ Store butter
- ❑ Hand-made butter
- ❑ Pint jar with lid
- ❑ Wooden spoon
- ❑ Butter plate
- ❑ Whipping cream
- ❑ Salt
- ❑ Cold water

Making the Butter (To be done in a clean area.)

1. Wash hands.
2. Break up the students into groups of 4 to 6
3. Pour the ½ pint of the liquid whipping cream into a pint jar. Screw on the lid.
4. Group of students take turns in shaking the jar (20 time each student until done).
5. It takes quite a while for the liquid whipping cream to turn into butter. The liquid whipping cream will first turn into whipped cream. This is the stage right before it turns into butter. The students may think this is the end. But, they have to keep shaking a little longer for the whipped cream to turn into butter.
6. It has turned into butter when the whipped cream has turned into liquid (buttermilk) and a glob of butter in the jar.
7. Pour the buttermilk out of the jar and into a cup. (Hold the lid of the jar over theopening, leaving a gap to pour out the buttermilk but keep the butter in the jar.)
8. Add cold water to the jar. Press the cold water into the butter with the wooden spoon to flush out the remaining buttermilk in the butter so the butter doesn't go rancid. Pour the water out in the sink as described in #7.

9. Add a pinch of salt to the butter and stir it with the wooden spoon. This will prevent it from going rancid and will add flavor.
10. Take the butter out of the jar with the wooden spoon and put it on a butter plate.
11. Weigh the butter and buttermilk and compare it to the weight of the cream. Did it change? Explain.
12. Ask the students what type of change did it go through? Explain. (Physical, because the butter only changed form but is made up of cream in another form.)
13. Have the students write down the uses of the butter by the colonists.
14. Have them write down any special observations and thoughts they had while they were making the butter.
15. Have the students write down on the activity sheet what kind of a change it is, and tell why.

Assessment Suggestions

- Review the students' activity sheets. Check for accuracy and completeness.
- Take pictures of the students at each of the activities. As the pictures are shown, have the students relate what is happening at each station. Have them relate whether it was a physical change or a chemical change.
- Make an assessment with each of the products of the two stations with pictures. Have the students tell if each product is a result of a physical change or a chemical change. Have them explain why.

Curriculum Extensions/Adaptations/ Integration

- The advanced learners can learn more about how cooking most things is a chemical change.
- The advanced learners can learn more about the tools used in the activities and about how they were made.
- The advanced learners can learn more about the physical and chemical reactions of each of the activities.
- The advanced learners can learn about other products that were made by colonists—how they are made and if the product is a result of physical or chemical change.
- For learners with special needs, there are many easy reader books in the library that tell about colonial living. After they read them, have them write if the product is a physical or chemical change.

Family Connections

- Send home the instruction sheets about how to make bread and butter. Have them make them at home with their family. The student can then explain if the products are chemical changes or physical changes and explain why to their family members.

Additional Resources

Books

Colonial Living, by Edwin Tunis; ISBN 9780801862274 (Paperback)

If You Lived in Colonial Times, by Ann McGovern; ISBN 059045160X (Paperback)

If You Lived In Williamsburg in Colonial Days, by Barbara Brenner; 0590929224 (Paperback)

Web sites

http://brebru.com/webquests/colonialtimes/lict/lict.html

http://www.lodi.k12.wi.us/schools/es/lmc/gr5Colonial.htm

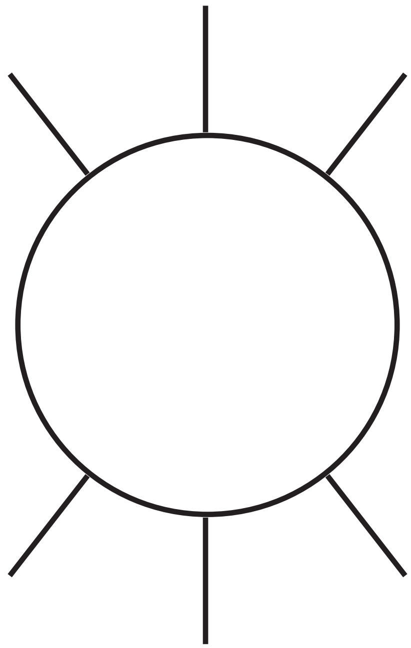
http://ri.essortment.com/coloniallifeco_rndd.htm

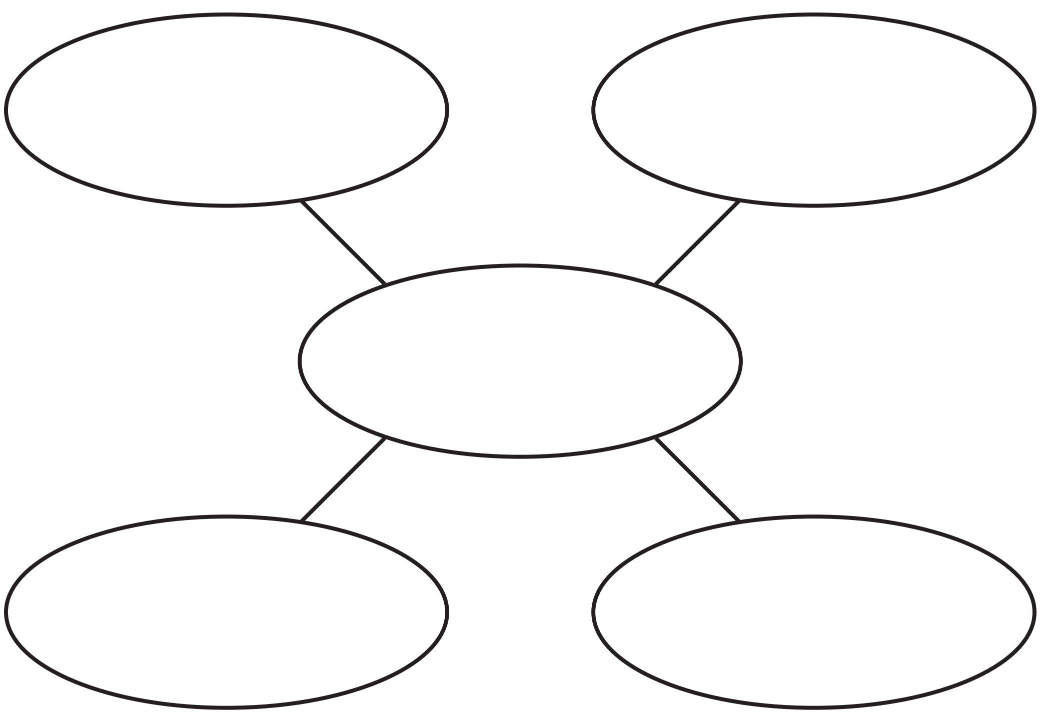
http://ag.ansc.purdue.edu/sheep/ansc442/Semprojs/2003/sweater/front.htm

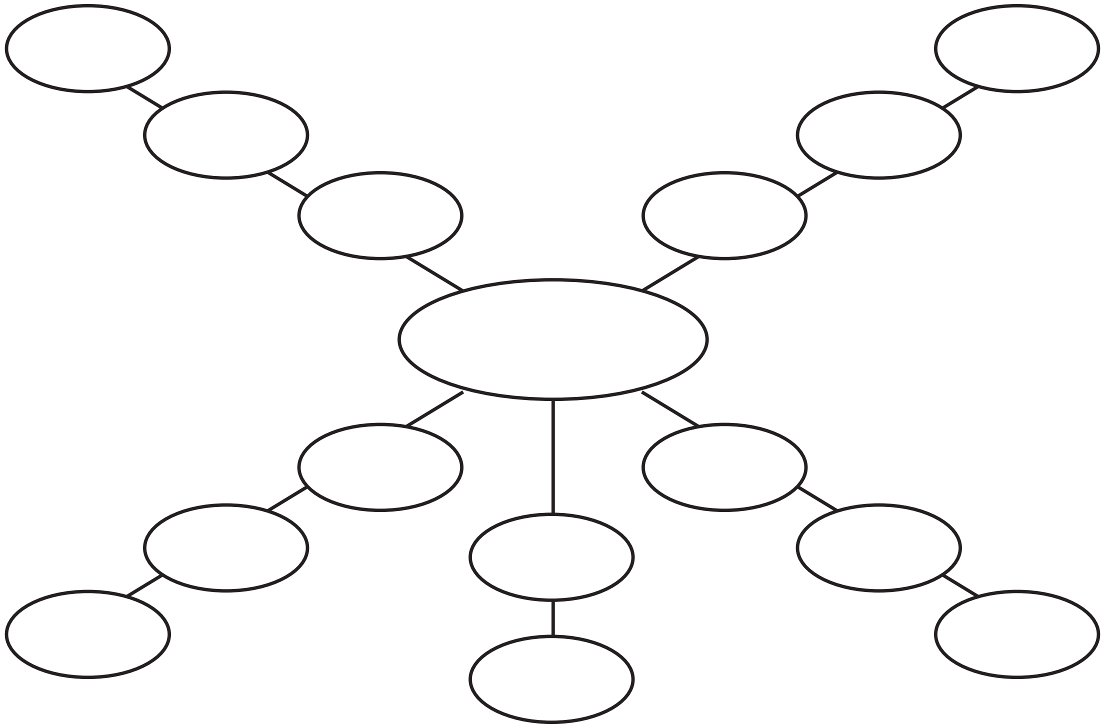
Organizations

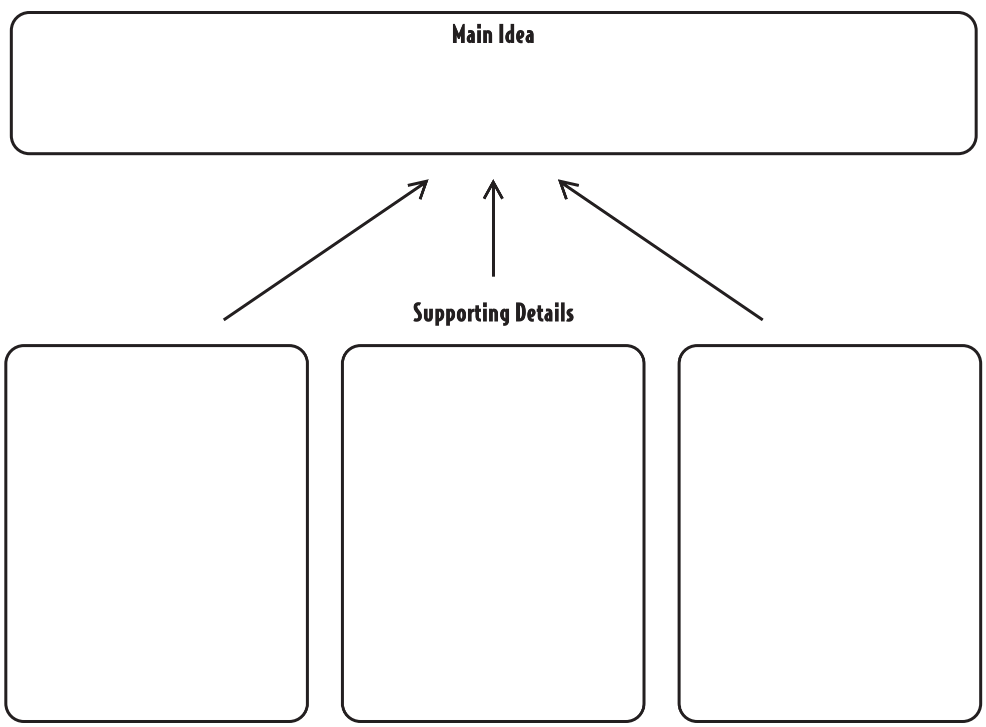
Williamsburg, http://en.wikipedia.org/wiki/Colonial_Williamsburg

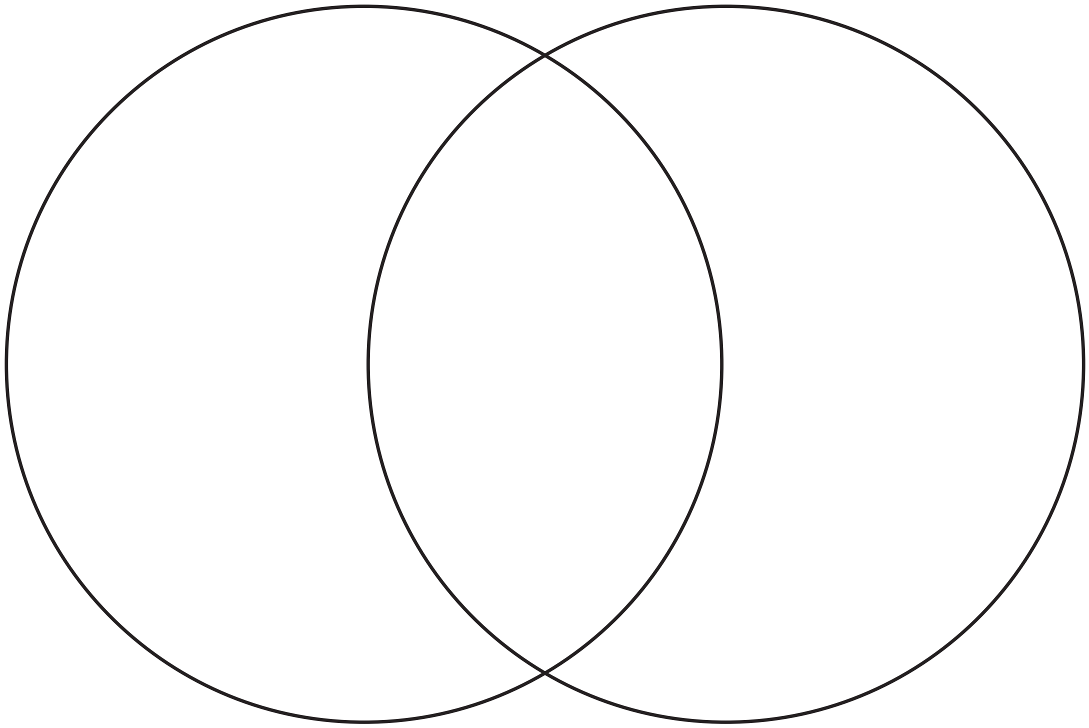
Graphic Organizers

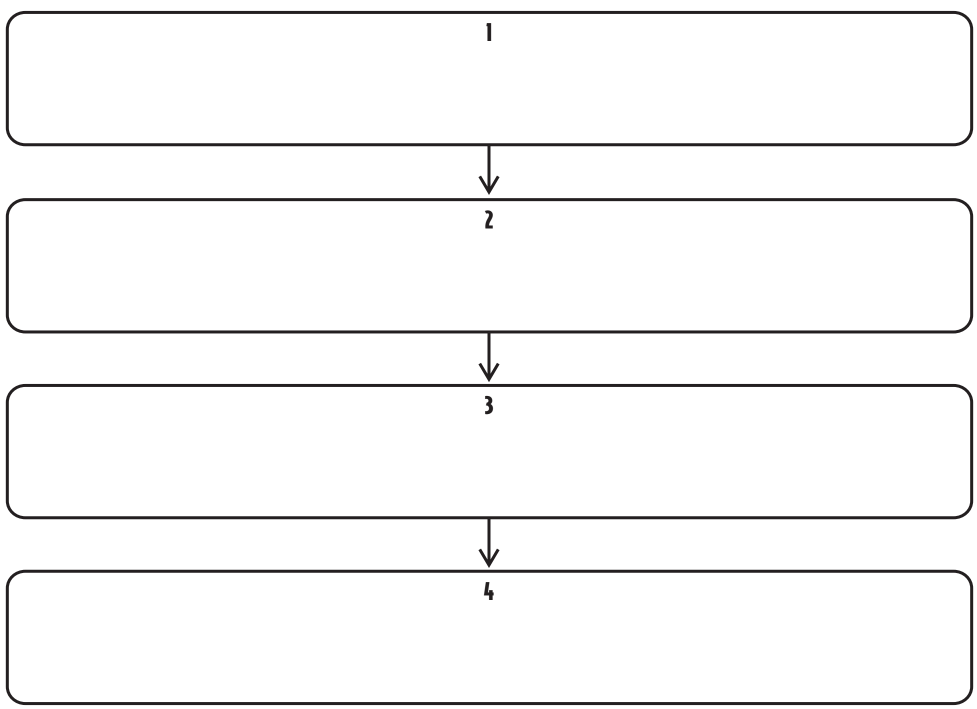







Main Idea
Supporting Details

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